Fishery Data Series No. 09-66

Tatlawiksuk River Salmon Studies, 2008

Annual Report for Study 07-304
USFWS Office of Subsistence Management
Fisheries Resource Monitoring Program

by

Travis B. Elison,

J. Michael Thalhauser,

and

Christopher A. Shelden

December 2009

Alaska Department of Fish and Game Divisions of Sport Fish and Commercial Fisheries

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	\$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye to fork	MEF
mideye to tail fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA SERIES NO. 09-66

TATLAWIKSUK RIVER SALMON STUDIES, 2008

by
Travis B. Elison
Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage

J. Michael Thalhauser
Kuskokwim Native Association, Aniak

and
Christopher A. Shelden
Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1565

December 2009

Development and publication of this manuscript was partially financed by the USFWS Office of Subsistence Management (Project 07-304) Fisheries Resource Monitoring Program under Agreement 701817J647. Matching funds were provided by Coastal Villages Region Fund and the State of Alaska.

ADF&G Fishery Data Series was established in 1987 for the publication of Division of Sport Fish technically oriented results for a single project or group of closely related projects, and in 2004 became a joint divisional series with the Division of Commercial Fisheries. Fishery Data Series reports are intended for fishery and other technical professionals and are available through the Alaska State Library and on the Internet: http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm This publication has undergone editorial and peer review.

Travis B. Elison
travis.elison@alaska.gov
Alaska Department of Fish and Game, Division of Commercial Fisheries,
333 Raspberry Road, Anchorage, AK 99518, USA

J. Michael Thalhauser
mthalhauser@kuskokwim.org
Kuskokwim Native Association, P. O. Box 127, Aniak, AK 99557
and
Christopher A. Shelden
chris.shelden@alaska.gov
Alaska Department of Fish and Game, Division of Commercial Fisheries,
333 Raspberry Road, Anchorage, AK 99518, USA

This document should be cited as:
Elison, T. B., J. M. Thalhauser, and C. A. Shelden. 2009. Tatlawiksuk River salmon studies, 2008. Alaska Department of Fish and Game, Fishery Data Series No. 09-66, Anchorage.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF APPENDICES

ABSTRACT

The Tatlawiksuk River weir has operated since 1998 to estimate the return and age-sex-length compositions of salmon escapements, monitor environmental variables, and facilitate other Kuskokwim Area fisheries projects. In 2008, a resistance board weir was operated in the Tatlawiksuk River from 15 June through 18 September to estimate escapements of 3 species of Pacific salmon *Oncorhynchus* spp. The total annual Chinook salmon *O. tshawytscha* escapement of 1,071 was below average. The total escapement of chum salmon *O. keta* (30,869) was near average. The total escapement of coho salmon *O. kisutch* (11,065) was above average. Age-sex-length samples taken from fish caught in a live trap were used to describe the age-sex structure of the Chinook, chum, and coho salmon escapements. Females comprised 39.0% of the Chinook salmon escapement, 52.3% of the chum salmon escapement, and 52.7% of the coho salmon escapement. The Chinook salmon escapement was comprised of 3 age classes, dominated by age-1.3 fish (57.4%). The chum salmon escapement was comprised of 5 age classes, dominated by age-0.4 fish (76.2%). The coho salmon escapement was comprised of 3 age classes, dominated by age-2.1 fish (84.3%).

The Tatlawiksuk River weir is one of several components, which form an integrated array of escapement monitoring projects in the Kuskokwim Area. This array of projects provides a means to monitor and assess escapement trends that must be considered in harvest management decisions in accordance with the State of Alaska's Policy for the Management of Sustainable Salmon Fisheries (5 AAC 39.222).

Key words: Chinook salmon, *Oncorhynchus tshawytscha,* chum salmon, *O. keta*, coho salmon, *O. kisutch*, longnose suckers, *Catostomus catostomus,* escapement, age-sex-length, ASL, Tatlawiksuk River, Kuskokwim River, resistance board weir, radiotelemetry, mark–recapture, stock specific run timing, upper Kuskokwim.

INTRODUCTION

The Kuskokwim River is the second largest river in Alaska, draining an area approximately 130,000 km^2, or 11% of the total area of Alaska (Figure 1; Brown 1983). Each year mature salmon *Oncorhynchus* spp. return to the river to spawn, supporting an annual average subsistence and commercial harvest of nearly 1 million salmon (Whitmore et al. 2008). The subsistence salmon fishery in the Kuskokwim Area is one of the largest and most important in the state (Coffing Unpublished[1],1991; Coffing et al. 2001; Whitmore et al. 2008) and remains a fundamental component of local culture. The commercial salmon fishery, though modest in value compared to other areas of Alaska, has been an important component of the market economy of lower Kuskokwim River communities (Buklis 1999; Whitmore et al. 2008). Salmon that contribute to these fisheries spawn and rear in nearly every tributary of the Kuskokwim River basin.

Since 1960, management of Kuskokwim River subsistence, commercial, and sport fisheries has been the responsibility of the Alaska Department of Fish and Game (ADF&G), though other agencies contribute to the decision making process. Management authority for the subsistence fishery was broadened in October 1999 to include the federal government under Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA). The U.S. Fish and Wildlife Service (USFWS) is the federal agency most involved within the Kuskokwim Area and tribal groups such as the Kuskokwim Native Association (KNA) are charged by their constituency to actively promote a healthy and sustainable subsistence salmon fishery. These and other groups have

[1] Coffing, M. *Unpublished* a. Kuskokwim area subsistence salmon harvest summary, 1996; prepared for the Alaska Board of Fisheries, Fairbanks, Alaska, December 2, 1997. Alaska Department of Fish and Game, Division of Subsistence, Bethel.
Coffing, M. *Unpublished* b. Kuskokwim area subsistence salmon fishery; prepared for the Alaska Board of Fisheries, Fairbanks, Alaska, December 2, 1997. Alaska Department of Fish and Game, Division of Subsistence, Bethel.

combined their resources to develop projects such as the Tatlawiksuk River weir to better achieve the common goal of providing for sustainable salmon fisheries in the Kuskokwim River.

In the state of Alaska, the goal of salmon management is to provide for sustainable fisheries by ensuring that adequate numbers of salmon escape to the spawning grounds each year. This goal requires an array of long-term monitoring projects that reliably measure annual escapement to key spawning systems as well as track temporal and spatial patterns in abundance that influence management decisions. Over time and with sufficient data, escapement goals can be developed as a means to gauge escapement adequacy, but current spawner-recruit models for escapement goal development require many years of data. In the Kuskokwim River, only 2 long-term, ground-based escapement monitoring projects have operated reliably for more than 10 years (Whitmore et al. 2008).

With dozens of tributaries known to support spawning populations of salmon, the presence of escapement monitoring projects on 2 tributaries was not adequate with respect to the entire Kuskokwim River basin. This deficiency was addressed with the establishment of several additional projects in the mid to late 1990s, including the Tatlawiksuk River weir in 1998 (Molyneaux and Brannian 2006). The data provided by the current array of projects have much greater utility for fishery managers (Holmes and Burtkett 1996; Mundy 1998) and have decreased reliance on aerial stream surveys, which are known to be imprecise (Whitmore et al. 2008).

In recent years, Kuskokwim River Chinook *O. tshawytscha* and chum *O. keta* salmon have received considerable attention by the Alaska Board of Fisheries (BOF) due to erratic run abundance patterns. The BOF designated Kuskokwim River Chinook and chum salmon as stocks of yield concern in 2000 based on chronically poor commercial harvest levels (Burkey et al. 2000; Ward et al. 2003). This “stock of yield concern” designation was upheld during the 2004 BOF meeting, but was removed during the 2007 BOF meeting at the recommendation of ADF&G following several years of expected harvest levels and relatively strong escapements (Bergstrom and Whitmore 2004; Molyneaux and Brannian 2006). Between 2001 and 2006 subsistence and commercial salmon fisheries were managed conservatively and in accordance with the BOF “stocks of yield concern” designations. Efforts were focused on enumerating abundance of these species and obtaining enough data for escapement goal development. Several main-river and regional projects arose that utilized the existing weir infrastructure for data collection (Pawluk et al. 2006; Stuby 2007). Such projects have since become deeply integrated components of the Kuskokwim monitoring program.

Although salmon production is modest, the Tatlawiksuk River contributes to sustainable fisheries both by adding to production and genetic diversity similar to what Hilborn et al. (2003) described for Bristol Bay. Since fishermen tend to harvest salmon from the early part of the runs and the early part of the runs may be dominated by upper river salmon stocks, salmon production from the upper Kuskokwim River may support a disproportionately high fraction of the subsistence harvest, particularly for Chinook salmon (K. Schaberg, Commercial Fisheries Biologist, ADF&G, Anchorage; personal communication). This latter point makes monitoring upper Kuskokwim River salmon escapements, such as on the Tatlawiksuk River, a particularly important tool for maintaining sustainable downriver fisheries.

The utility of weirs extends beyond providing annual escapement estimates. Escapement projects commonly serve as platforms for collecting other types of information useful for management and research. Collection of age, sex, and length (ASL) data is typically included in most escapement monitoring projects (Molyneaux et al. 2008). Knowledge of ASL composition can improve understanding of fluctuations in salmon abundance and is essential for identifying spawner-recruit relationships that are used in formulating escapement goals (DuBois and Molyneaux 2000).

The Tatlawiksuk River weir also serves as a platform for collecting information on habitat variables including water temperature and stream discharge (stage), which may directly or indirectly influence salmon productivity and timing of migrations (Hauer and Hill 1996; Kruse 1998; Quinn 2005). These variables can be affected by human activities (i.e., mining, timber harvesting, man-made impoundments, etc.; NRC 1996) or broader climatic variability (e.g., El Nino and La Nina events).

BACKGROUND

The Tatlawiksuk River is a tributary of the middle Kuskokwim River basin that provides spawning and rearing habitat for Chinook, chum, and coho salmon (ADF&G 1998) and has a history of subsistence use. According to Elders of nearby communities, Athabaskan groups routinely harvested salmon from the Tatlawiksuk River until the mid-1900s (Andrew Gusty Sr., Resident, Stony River village; personal communication). Periodically during the last 40 years ADF&G biologists have observed salmon escapements in the mainstem Tatlawiksuk River during aerial surveys (Burkey and Salomone 1999; D. J. Schneiderhan, Kuskokwim stream catalog, 1954–1983, Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage).

Salmon escapement monitoring began at the Tatlawiksuk River in 1998 through the joint effort of KNA and ADF&G (Linderman et al. 2002). Operations in 1998 were incomplete and the fixed-panel weir design was replaced with a resistance board weir in 1999, which improved performance in subsequent years. Since then, the Tatlawiksuk River weir has been collecting escapement and ASL composition information on Chinook, chum, coho, and sockeye salmon escapement; habitat and climatic variables; and has served as a platform for other collaborative research efforts (Stewart et al. 2008).

OBJECTIVES

1. Determine daily and total annual Chinook, chum, and coho salmon escapements to Tatlawiksuk River from 15 June to 20 September.
2. Estimate the age, sex, and length composition of annual Chinook, chum, and coho salmon escapements to the Tatlawiksuk River such that 95% confidence intervals of age composition are no wider than ±10% (α=0.05 and d=0.10).
3. Monitor habitat variables including daily water temperature, water level, and stream discharge.
4. Provide mentorship and administer education curriculum to KNA high school interns.
5. Serve as a platform to facilitate current and future fisheries research projects by:
    a. Serving as a monitoring location for *Temperature Monitoring*;

b. Serving as a monitoring location for coho salmon equipped with radio transmitters and anchor tags deployed as part of *Kuskokwim River Coho Salmon Investigations*; and

c. Serving as a collection location for *Investigation of Stable Isotope and Otolith Elemental Analyses as Tools for Salmon Stock Assessment*.

The primary goal of this report is to summarize and present the results for the 2008 field season at the Tatlawiksuk River weir. Secondary to this, we intend to provide a more holistic perspective of Kuskokwim Area fisheries by placing the 2008 findings into the broader spatial and temporal context. To do this we draw heavily on data from past years at this project to highlight temporal trends and we draw on data from other escapement monitoring projects, related research projects, and commercial and subsistence fisheries to highlight spatial trends. These goals are intended to enhance the utility of this report beyond simply archiving data. It is important to note that some of the data used to make these broader comparisons are preliminary and effort was made to ensure that all preliminary data was reported as such. In addition, many of the referenced documents are currently being developed. Consequently, most of the reported trends for other projects were determined by the authors of this report based on finalized data sets generously provided by other researchers. Furthermore, unless stated, the statistical significance of the trends discussed for this and other escapement monitoring projects have not been determined. Many of these trends are subjective and based on low sample sizes with high variance. It is important to remember that sampling methodologies may differ across projects and over time, leading to difficulty in comparisons. Throughout this document every effort was made to ensure sound comparisons; however, the reader should be aware of these potential issues and receive broader spatial and temporal trends with caution.

METHODS

STUDY AREA

Tatlawiksuk River originates in the foothills of the Alaska Range and flows southwesterly for 113 km, draining an area of approximately 2,106 km^2 before joining the Kuskokwim River at river kilometer (rkm) 553 (Figure 2; Brown 1983). Throughout most of the river's course, it meanders across wide, flat valleys vegetated with white spruce and scattered birch or aspen. Black spruce is more characteristic in poorly drained areas of the basin and dense stands of willow and alder occur on sand and gravel bars. Unnamed streams that join the Tatlawiksuk River from the southeast and northeast drain extensive bog flats and swampy lowlands in the lower reaches of the basin. The channel gradient of the lower 80 km is approximately 1.5 m per km (Brown 1983).

WEIR DESIGN

Installation Site

The Tatlawiksuk River weir site is located approximately 4.5 rkm upstream from the mouth of the Tatlawiksuk River, 36 rkm upstream from the village of Stony River, and 557 rkm from the mouth of the Kuskokwim River (Figures 1 and 2). Salmon spawning in the Tatlawiksuk River downstream of the weir site is assumed to be negligible. At the weir site, the Tatlawiksuk River is about 64 m wide and has a depth of about 1 m during normal summer operations. The weir was positioned in the center of a wide bend, adjacent to a high cut bank to the east and a small floodplain to the west. Dense patches of alder and willow suggest that the floodplain is at an intermediate stage of succession and terracing of the floodplain indicates that the stream channel has shifted course many times. The floodplain is interspersed with small channels that remain isolated except in periods of extreme high water.

Construction

The Tatlawiksuk River weir is termed a "resistance board weir." Tobin (1994) describes details of the design and construction and Stewart (2002) describes the changes implemented for the Tatlawiksuk River weir. Each year the weir is installed across the 210 ft (64 m) channel following the techniques described by Stewart (2003). The substrate rail and resistance board panels cover the middle 190 ft (58 m) portion of the channel and fixed weir materials extend the weir 10 ft (3 m) to each bank. The pickets are 1-5/16 in (3.33 cm) in diameter and spaced at intervals of 2-5/8 in (6.67 cm) to leave a gap of 1-5/16 in (3.33 cm) between each picket.

Most fish passage intentionally occurs through the fish trap, which is annually installed within the deeper portion of the stream channel. The fish trap is about 2.5 m long (parallel to channel) and 1.5 m wide (perpendicular to channel) and has 2 gates: one facing downstream and one facing upstream. After all panels are installed across the river, one is removed where the trap is to be installed and modified weir panels are fastened to the side of each panel adjacent the opening. The trap is lowered into the river just upstream of the rail with its downstream gate centered on the gap. The modified panels are butted against the trap frame to maintain the weir's integrity. The trap can be easily configured to pass fish freely upstream or to capture individuals for sampling.

A skiff gate is installed within a deeper section of the river to facilitate both jet-driven and propeller-driven boat traffic. The skiff gate consists of panels modified to submerge under the weight of passing boats. Generally, boat operators can pass with little or no involvement with the weir crew. Boats with jet-drive engines are the most common and could pass up or downstream over the skiff gate after reducing speed to 5 miles per hour or less.

To accommodate downstream migration of longnose suckers *Catostomus catostomus* and other species, downstream passage chutes are incorporated into the weir once resident species are observed congregating upstream. At locations where downstream migrants are most concentrated, chutes are created by releasing the resistance boards on 1 or 2 adjacent weir panels so the distal ends dip slightly below the stream surface. The chute's shallow profile guides downstream migrants, but prevents upstream salmon passage. The chutes are monitored and adjusted to ensure salmon are not passing upstream. Downstream salmon passage is not enumerated; however, few salmon have been observed passing downstream over these chutes and their numbers are not considered significant.

Maintenance

The weir is cleaned once or twice each day, typically at the end of a counting shift. To clean the weir, a technician walks along the floating end. The added weight on the distal end partially submerges each panel and allows the current to wash debris downstream. A rake is used to push larger debris off the weir. Each time the weir is cleaned; panels are inspected for damage and the substrate rail is inspected to check for scour. Periodically, a more thorough inspection is performed by snorkeling along the rail.

ESCAPEMENT MONITORING

The Tatlawiksuk River weir operates according to a “target operational period” that encompasses virtually the entire runs of Chinook, chum, and coho salmon and provides for consistent comparisons among years. The target operational period for Tatlawiksuk River weir has been established as 15 June through 20 September. Annual operational dates may vary due to stream conditions and anomalies in run timing and/or abundance. Reported daily and annual Chinook, chum, and coho salmon escapements consist of observed plus any estimated passage. Counts of all other species, including sockeye and pink salmon, are reported as observed passage; expected missed passage is not estimated.

Passage Counts

Passage counts are conducted periodically during daylight hours. Substantial delays in fish passage occur only at night or during ASL sampling. Crew members visually identify each fish as it passes upstream and record it by species on a multiple tally counter. Counting continues for a minimum of 1 hour or until passage substantially decreases. Counting effort is adjusted as needed to accommodate migratory behavior and abundance of fish, or operational constraints such as reduced visibility in evening hours late in the season. Crew members record the total upstream fish count in a designated notebook. At the end of each day; total, daily, and cumulative counts are copied to logbook forms. These counts are reported each morning to ADF&G staff in Bethel via single side band radio or satellite telephone.

A live trap is used as the primary means of upstream fish passage. Fish are counted as they enter the downstream end of the trap. Proper identification is enhanced by use of a clear-bottom viewing box that reduces glare and water turbulence. In addition to aiding in species identification, this tool allows observers to see and trap tagged fish in support of tagging projects, such as *Kuskokwim River Coho Salmon Investigations* in 2008. Costello et al. (2007) describes other methods that are occasionally used when salmon are reluctant to enter the fish trap, such as during periods of extreme low water.

Estimating Missed Passage

To better assess total escapement, upstream salmon passage is estimated for days when the weir is not operational within the target operational period. When historical data indicate that passage of a particular species on an inoperable day is probably negligible, passage is assumed to be zero without performing any calculations. However, when historical records indicate that passage of a particular species is likely considerable, 1 of the 4 formulas listed below are used to calculate potential missed passage. The method used depends on the duration and timing of the inoperable periods.

Single Day

When the weir is not operational for part or all of one day, an estimate for the inoperable day is calculated using the following formula:

$$\hat{n}_{d_i} = \left(\frac{\left(n_{d_i-2} + n_{d_i-1} + n_{d_i+1} + n_{d_i+2} \right)}{4} \right) - n_{o_i} \qquad (1)$$

where:

n_{d_i-1}, n_{d_i-2} = observed passage of 1, 2 days before the weir was washed out;

n_{d_i+1}, n_{d_i+2} = observed passage of 1, 2 days after the weir was reinstalled; and,

n_{o_i} = observed passage (if any) from the given day (i) being estimated.

Linear Method

When the weir is not operational for 2 or more days and later becomes operational, passage estimates for the inoperable days are calculated using the following formula:

$$\hat{n}_{d_i} = (\alpha + \beta \cdot i) - n_{o_i} \tag{2}$$

$$\alpha = \frac{n_{d_i-1} + n_{d_i-2}}{2}$$

$$\beta = \frac{\left(n_{d_i+I} + n_{d_i+I+1}\right) - \left(n_{d_i-1} + n_{d_i-2}\right)}{2\left(I+1\right)}$$

where:

I = number of inoperative days (I>2), and

n_{d_i+I}, n_{d_i+I+1} = observed passage the first day after the weir was reinstalled.

Proportion Method

In circumstances when the weir does not first become operational until well into the one or more salmon runs, or when the weir ceases operating before data suggest salmon runs are nearing completion, daily passage for inoperable days is estimated using passage data from another year at the Kogrukluk River weir or from a neighboring project. The dataset used to model escapement for a particular situation is selected because it exhibits similar passage patterns to the incomplete dataset. With this method, daily passage estimates are calculated using the following formula:

$$\hat{n}_{d_i} = \left(\frac{\left(n_{md_i} \times \sum n_{d_i}\right)}{\sum n_{md_i}}\right) - n_{o_i} \tag{3}$$

where:

n_{md_i} = passage for the i^{th} day in the model data;

$\sum n_{d_i}$ = cumulative passage;

$\sum n_{md_i}$ = cumulative passage of the model data for the corresponding time period; and,

n_{o_i} = observed passage (if any) from the given day (i) being estimated.

Exponential Method

When model data sets are not adequate to use the "proportion method" the "exponential method" can be used. This method uses non-linear regression to fit an exponential function to existing data. For estimating the beginning of a run, use the rising limb of the run curve to fit an exponential trend line. For estimating the end of a run, use the falling limb of the run curve to fit an exponential trend line. Using this method the trendline is fitted to the data using the exponential function:

$$\hat{n}_{d_i} = ae^{bi} \tag{4}$$

where:

a = y-intercept of the fitted line

b = slope of the fitted line

i = day of the estimated portion of the run

Carcasses

Spawned out and dead salmon (hereafter referred to as carcasses) that washed up on the weir were visually identified by species and sex and passed downstream. Daily carcass counts were recorded in the camp log.

AGE, SEX, AND LENGTH COMPOSITION

To estimate age, sex, and length composition of annual Chinook, chum, and coho salmon escapements, live sampling was conducted as fish migrated upstream through the weir. Samples were collected throughout the season to account for temporal dynamics in ASL characteristics. Samples were stratified postseason to develop weighted estimates.

Sample Size and Distribution

A minimum sample size was determined for each species following conventions described by Bromaghin (1993) to achieve 95% confidence intervals of age-sex composition no wider than ±10% (α=0.05 and d=0.10), assuming 10 age-sex categories for Chinook salmon (n=190), 8 age-sex categories for chum salmon (n=180), and 6 age-sex categories for coho salmon (n=168). These sample sizes were then increased by about 20% to account for unreadable scales or collection errors. This yielded a minimum collection goal for each sample of 230 Chinook, 220 chum, and 200 coho salmon.

The abundance of chum and coho salmon at Tatlawiksuk River weir is generally high enough to collect a large sample size in a short period of time. A pulse sampling strategy was therefore employed to ensure adequate temporal distribution of chum and coho salmon samples. The term "pulse" is used to describe an instantaneous sample, though in practice a pulse sample is typically collected over the period of a few days. Well spaced pulse samples are thought to have greater power for detecting temporal changes in ASL composition than other sampling methods (Geiger and Wilbur 1990). Pulse sampling was conducted approximately every 7–10 days. The goal was to collect a minimum of one pulse sample from each third of the run.

The relatively low abundance of Chinook salmon at Tatlawiksuk River weir makes pulse sampling impractical. Instead, sampling effort followed a daily collection schedule based on historical run timing information using a sample size of 230 fish (Molyneaux et al. *In prep*). Daily sample sizes were proportional to average historical escapements by day to ensure a good distribution across the run. The overall sample size was selected to exceed the minimum necessary to meet precision and accuracy criteria for this location and was similar to average historical sampling success.

Sample Collection Procedures

Salmon were sampled from the fish trap installed in the weir. The trap included an entrance gate, holding pen, and exit gate. Salmon were trapped by opening the entrance gate while the exit gate remained closed. Fish were allowed to swim freely into the holding box. The entrance doors to the trap can be arranged in a V-shape, or fyke to prevent fish from easily escaping. The holding box was allowed to fill with fish until a reasonable number was inside. Short handled dip nets were used to capture fish within the holding box. To obtain length data and aid in scale collection, fish were removed from the dip net and placed into a partially submerged fish "cradle." Scales were taken from the preferred area of the fish (INPFC 1963) and transferred to numbered gum cards (DuBois and Molyneaux 2000). Sex was determined through visual examination of the external morphology, focusing on the prominence of a kype, roundness of the belly, and the presence or absence of an ovipositor. MEF length was measured to the nearest millimeter using a straight-edged meter stick. Sex and length data were recorded on standardized numbered data sheets that correspond with numbers on the gum cards used for scale preservation. After sampling, each fish was released upstream of the weir. The procedure was repeated until the holding box was emptied.

Chinook salmon samples were often collected through "active sampling," which consisted of capturing and individually sampling while actively passing and counting all salmon. Further details of the active sampling procedures are described in Linderman et al. (2002). This method was also used for tag recoveries.

After sampling was completed, relevant information such as sex, length, sampling date, and sampling location was copied to computer mark-sense forms that correspond to numbered gum cards. The completed gum cards and mark-sense forms were sent to the Bethel and/or Anchorage ADF&G offices for processing. The original ASL gum cards, acetates, and mark-sense forms were archived at the ADF&G office in Anchorage. The computer files were archived by ADF&G in the Anchorage and Bethel offices. Data were also loaded into the Arctic-Yukon-Kuskokwim (AYK) salmon database management system (Brannian et al. 2006).

Data Processing and Reporting

Samples were aged and processed by ADF&G staff in Bethel and Anchorage following procedures described by Molyneaux and Folletti (2007). Samples were partitioned into a minimum of 3 temporal strata, based on overall distribution within the run. The escapement in each stratum was divided into age-sex classes proportionately with strata sample composition. Mean length by age-sex class was determined for each stratum as well. Annual estimates were calculated as strata sums, weighted by the abundance in each stratum. When sample size or distribution was not considered adequate to estimate annual ASL composition, results were reported, but not applied to annual escapements.

Age is reported in the European notation, composed of 2 numerals separated by a decimal. The first numeral represents the number of winters the juvenile spent in freshwater excluding the first winter spent incubating in the gravel, and the second numeral is the number of winters it spent in the ocean (Groot and Margolis 1991). The total age is therefore one year greater than the sum of these 2 numerals.

WEATHER AND STREAM OBSERVATION

Water and air temperatures (in °C) were manually measured each day at approximately 0730 and 1700 hours. Temperature readings were recorded in the logbook, along with notations about cloud cover, wind direction, wind speed, and precipitation. Wind speed was estimated to the nearest 5 miles per hour, and daily precipitation was measured (in millimeters) using a rain gauge. As in 2005–2007, water temperature readings were also obtained using a Hobo® Water Temp Pro v.1[2] data logger installed at mid-channel near the stream bottom. The data logger was programmed to record water temperature every hour (on the hour) during the weir operational period. Records were retrieved at the end of the season and archived for future comparisons.

Water level observations represented the stream height in centimeters above an arbitrary datum plane. Water levels were measured using a staff gage installed about 150 meters downstream from the weir. The staff gage, which is installed annually, was calibrated using a sight level to a reliable benchmark installed in 2005 (Costello et al. 2006; Appendix A1), which replaced semi-permanent benchmarks installed in previous years (Stewart and Molyneaux 2005).

Stream discharge was measured by wading a cross-section approximately 100 meters downstream of the weir and taking velocity measurements in 2.5 meter sections. Velocity was measured at 0.6 of stream depth using a Price Model AA Flow Meter® with a top-set wading rod and a Scientific Instruments' CDM 9000 DIGIMETER®. Discharge in each section is the product of the area and the measured velocity in each section. Total discharge is the sum of the discharges in each section.

KNA HIGH SCHOOL INTERNSHIP PROGRAM

Local area high school students were recruited to spend 1 or 2 weeks at various KNA fisheries projects including the Tatlawiksuk River weir. Students participated in passage counts, ASL sample collections, and weather and stream measurements under the supervision of project crew members. The KNA educator, aided by biologists and technicians, administered a curriculum of daily educational assignments and field activities. The curriculum was developed by KNA and the Kuspuk School District (KSD) teachers and is part of a KNA education and outreach project designed to meet Alaska State education standards using local monitoring and research projects to teach math and biological and social sciences with an emphasis on fisheries biology, ecology, and management and fisheries career opportunities. Following successful completion of the internship, the students receive a $250 stipend and their work is sent to their respective teachers in order for them receive credit for their work. Detailed methods of the KNA Natural Resources Internship Program are described in Orabutt and Diehl (2006).

RELATED FISHERIES PROJECTS

Kuskokwim River Coho Salmon Investigations

The Tatlawiksuk River weir served as a recovery site for the first season of a 2 season basin wide mark–recapture and radiotelemetry study entitled *Kuskokwim River Coho Salmon Investigations* funded by Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative. The project was designed to estimate coho salmon abundance, distribution, and run timing above the upper Kalskag tagging site (rkm 270), as well as produce a statistical model that would compute historical annual

---

[2] Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

abundance estimates from known escapement data. Coho salmon were captured at upper Kalskag and tagged using individually numbered Floy® anchor tags. A subset of tagged coho received an individually coded radio tag. Adipose fin clips were used as a secondary mark. Tagging methods are described by (Stuby 2007).

Whenever possible, tagged coho salmon observed passing through the weir's live trap were captured to recover tag information. Recorded data for "recovered" fish included the tag number, tag color, condition, presence of secondary mark, and recovery date. When a tagged fish was not captured it was recorded as "observed" along with the tag color and passage date. Tag loss was assessed at the weir by inspecting for secondary marks during routine ASL sampling.

This project built on an established network of telemetry tracking stations set up in support of Stuby (2007), with additional stations to increase the resolution of coho salmon distribution. The Tatlawiksuk River weir crew maintained stations on the Tatlawiksuk, Stony, Hoholitna, lower Holitna, and Holitna Rivers and a station on the mainstem Kuskokwim River at Sinka's landing. All data collected by the crew was transferred to the principal investigator on an opportunistic basis.

Temperature Monitoring

The Tatlawiksuk River weir serves as a monitoring site for the *Temperature Monitoring* project funded by Office of Subsistence Management, Fishery Resource Monitoring Program (FRMP 08-701). The contractor provided the monitoring equipment to the principal investigator for installation at the weir site. Two Hobo® Water Temp Pro V2 data loggers and two Hobo® Air Temperature R/H data loggers were installed at the beginning of the field season. The water temperature loggers were anchored to the bottom near mid-channel and the air temperature loggers were installed using a solar shield attached to a pole. At the end of the field season one water temperature logger and one air temperature logger were removed and the remaining temperature loggers were downloaded using the provided data shuttle and left to continue monitoring temperature. The removed temperature loggers and data shuttle were returned to the contractor for data management and reporting and logger maintenance and storage.

Otolith Collection

Otoliths were collected from chum salmon carcasses in support of 2 pilot investigations looking into the utility of microchemical analysis for stock identification. Crews collected carcasses from the weir on an opportunistic basis. Carcasses were examined to ensure that the fish had spawned above the weir, and spawned out fish were assumed to be returning members of Tatlawiksuk River stocks. A goal was set to collect otoliths from 20 male and 20 female chum salmon carcasses. Carcasses were rated 1 to 4 based on gill color, with red gills given a 1 and no color given a 4. Saggital otoliths were collected only from fish given a rating of 1 or 2 to ensure sample quality. Plastic forceps were used to extract the samples to prevent contamination from foreign metals. Fresh forceps were used on each sample to prevent contamination between samples. Otoliths from each fish were placed in separate envelopes with location, length, and sex information recorded on the outside. The envelopes were sent to the USFWS (F. Harris, Principle Investigator, USFWS, Kenai Fisheries Resource Office, Kenai) and the University of Alaska Fairbanks (T. Sutton, Principle Investigator, University of Alaska, Fairbanks).

RESULTS

ESCAPEMENT MONITORING

Installation of the Tatlawiksuk River weir began on 10 June and was completed at 2100 hours on 14 June, the day before the target operational start date. Weir removal began on 19 September and was completed on 21 September. Weir integrity was breached 4 times during the target operational period. The most substantial breach occurred from 29 June to 7 July when the weir became inoperable due to high water. The "linear method" was used to estimate Chinook and chum salmon passage during this time. On 12 July a hole large enough for fish to pass through was discovered. The "single day method" was used to estimate Chinook and chum salmon on this day. Coho salmon passage was assumed to be zero for the above periods. On the morning of 19 July, a hole large enough for fish to pass through was noticed. Based on hourly passage counts, it was assumed to have occurred the day before. The "linear method" was used to estimate Chinook, chum, and coho salmon for these 2 days. Weir operations were terminated on 19 September due to low fish passage. The "exponential method" was used to estimate coho salmon passage for the remaining 2 days of the target operational period. Chinook and chum salmon passage was assumed to be zero for these days.

Chinook Salmon

An estimated total of 1,071 Chinook salmon passed upstream of the Tatlawiksuk River weir during the target operational period in 2008 (Table 1). Estimates of missed passage accounted for 10% of the total reported estimated escapement. The first Chinook salmon was observed on 26 June and the last was observed on 25 August. Daily passage peaked at 150 Chinook salmon on 14 July. Based on total estimated escapement during the target operational period, the median passage date was 17 July and the central 50% of the run occurred between 14 and 23 July (Table 1; Figure 3).

Chum Salmon

An estimated total of 30,896 chum salmon passed upstream of the Tatlawiksuk River weir during the target operational period in 2008 (Table 1). Estimates of missed passage accounted for 16% of the total reported escapement. The first chum salmon was observed on 16 June and the last was observed on 17 September, 2 days before the end of weir operations. Daily passage peaked at 2,102 chum salmon on 14 July. Based on total estimated escapement during the target operational period, the median passage date was 17 July and the central 50% of the run occurred between 12 July and 23 July (Table 1; Figure 3).

Coho Salmon

An estimated total of 11,065 coho salmon passed upstream of the Tatlawiksuk River weir during the target operational period in 2008 (Table 1). Estimates of missed passage accounted for less than 1% of the total reported escapement. The first coho salmon was observed on 24 July and the last was observed on 18 September, the last day of weir operations. Daily passage peaked at 697 coho salmon on 20 August. Based on total estimated escapement during the target operational period, the median passage date was 19 August and 50% of the run occurred between 14 and 25 August (Table 1; Figure 3).

Other Species

Sockeye Salmon

A total of 39 sockeye salmon were observed passing upstream of the Tatlawiksuk River weir during the target operational period in 2008. The first sockeye salmon was observed on 10 July and the last was observed on 28 August. Based on total observed escapement during the target operational period, the median passage date was 19 August and the central 50% of the run occurred between 28 July and 15 August (Table 1).

Pink Salmon

Pink salmon *O. gorbuscha* are rare in the Tatlawiksuk River. A total of 19 pink salmon were observed passing upstream in 2008. The first and last pink salmon were observed on 19 July and 12 August, respectively (Appendix B1).

Non-Salmon Species

Four non-salmon fish species were observed passing upstream of the weir in 2008. Longnose suckers were the most abundant, with 3,385 observed passing the weir during the operational period. Other fish observed passing upstream of the weir in 2008 included 10 northern pike *Esox lucius*, 3 whitefish *Coregonus* sp., and 2 Arctic grayling *Thymallus arcticus* (Appendix B1).

Carcasses

A total of 1,474 salmon carcasses were recovered on the Tatlawiksuk River weir in 2008. Chum salmon were the largest component of the total carcass recovery (1,429), followed by Chinook salmon (23), coho salmon (14), and pink salmon (8). No sockeye salmon carcasses were recovered. Females comprised 29% of the chum salmon carcasses, 74% of the Chinook salmon carcasses, and 29% of coho salmon carcasses (Appendix C1). Other species included longnose suckers (93), whitefish (145), northern pike (13), Arctic grayling (4), and sheefish *leucichthys nelma* (3) (Appendix C1).

AGE, SEX, AND LENGTH COMPOSITION

Chinook Salmon

Sampling was conducted on an opportunistic basis from 8 July to 25 July, resulting in a total sample of 119 Chinook salmon. Of those, age was determined for 93 fish (78% of the total sample), or 8.7% of the annual Chinook salmon escapement. The escapement was partitioned into 2 temporal strata based on sampling dates, with sample sizes of 56 and 37 for the first and second strata, respectively. Overall, 95% confidence intervals for age composition of annual escapement were no wider than ±10% (Table 2).

Chinook salmon sampled in 2008 were comprised of 3 age classes (age-1.2, -1.3, and -1.4). Based on ASL sampling, the 2008 Chinook salmon escapement was dominated by age-1.3 (57.4%), followed by age-1.4 (32.3%), and age-1.2 fish (10.3%) (Table 2). With regards to intra-annual variation of the percent composition, the percentage of age-1.4 fish varied the greatest with an increase from 26.8% to 37.8%. The percentage of age-1.2 and age-1.3 fish decreased slightly as the run progressed. Age-1.3 fish remained the greatest percentage (60.7% to 54.1%) and age-1.2 remained the weakest percentage (12.5% to 8.1%) (Table 2; Figure 4).

Based on ASL sampling, the ratio of males to females past the Tatlawiksuk River weir was approximately 3:2. Female Chinook salmon comprised 39% (418 fish) of the annual escapement (Table 2). The percentage of females increased by 3% as the run progressed (Figure 5). The majority of older fish were female (62.4% of age-1.4), while the younger age classes were dominated by males (91.8% of age-1.2 and 68.7% of age 1.3).

Based on pooled season samples, on average, length-at-age of females appears to be greater than length-at-age of males (Figure 6). Lengths ranged from 620 to 944 mm in females and from 493 to 932 mm in males (Table 3). Mean lengths of female Chinook salmon were 720 mm at age-1.3 and 795 mm at age-1.4. Mean lengths of male Chinook salmon were 567, 690, and 742 mm at age-1.2, 1.3, and 1.4, respectively.

Chum Salmon

ASL samples were collected from 8 July to 22 August, from a total of 964 fish. Of those, age was determined for 799 chum salmon (82.8% of the total sample), or 2.6% of the annual chum salmon escapement. The chum salmon run was partitioned into 4 strata based on sampling dates, with sample sizes of 204, 188, 211, and 196 fish per stratum. Overall, 95% confidence intervals for age composition percentages were no wider than ±3% (Table 4).

The annual chum salmon escapement in 2008 was mostly comprised of age-0.4 fish (76.2%). Age-0.3 fish represented 21.3% of escapement, followed by age-0.5 (2.0%), and age-0.2 (0.5%) (Table 4). Age-0.4 fish decreased from a maximum of 90.2% in the first stratum to a minimum 60.7% in the last stratum, while age-0.3 fish increased from a minimum of 8.8% in the first stratum to a maximum of 34.2% in the last stratum (Figure 7).

Based on ASL sampling, the percentage of males and females in the chum salmon escapement past the Tatlawiksuk River weir was approximately equal. Female chum salmon comprised 52.3% of the total annual escapement based on weighted samples (Table 4). The percent contribution of females increased over the course of the run from a minimum of 46.6% in the first stratum to a maximum of 57.1% in the last stratum (Figure 5).

Mean lengths for the dominant chum salmon age-sex classes were determined. Mean lengths for age-0.3 and -0.4 males were 562 mm and 580 mm respectively. Mean lengths among age-0.3 and -0.4 females were 533 mm and 548 mm, respectively. Male lengths ranged from a minimum of 494 mm to a maximum of 659 mm. Female lengths ranged from a minimum of 445 mm to 637 mm (Table 5). Males had greater mean length-at-age than females (Figure 6).

Coho Salmon

Sampling was conducted periodically from 8 August to 14 September resulting in a total sample of 605 coho salmon. Of those, age was successfully determined for 485 fish (80.2% of the sample) or 5.5% of the annual coho salmon escapement. The coho salmon run was partitioned into 3 strata based on sampling dates, with sample sizes of 83, 237, and 165 fish per stratum. Overall, 95% confidence intervals for each combined age strata were no wider than ±3% (Table 6).

The annual coho salmon escapement was mostly comprised of age-2.1 fish, which accounted for 84.3% of the total escapement, followed by age-3.1 (11.9%), and age-1.1 (3.8%) (Table 6). The percentage of age-2.1 fish ranged from a maximum of 94% in the first stratum to a minimum of 69.1% in the last, while age-3.1 fish ranged from a minimum of 3.6% in the first stratum to a maximum of 26.7% in the last (Figure 8).

Based on ASL sampling the percentage of males to females was approximately equal. Females comprised 52.7% of the total escapement (Table 6). The percentage of females was near 51% in the first 2 strata and increased to 61.2% in the last stratum (Figure 5).

With all strata combined, sample sizes were large enough to determine mean lengths for each age-sex class. Mean male lengths were 526, 539, and 548 mm for age-1.1, -2.1, and -3.1 fish, respectively. Mean female lengths were 548, 544, and 546 mm for age-1.1, -2.1, and -3.1 fish, respectively. Male lengths ranged from a minimum of 415 mm to a maximum of 618 mm. Female lengths ranged from a minimum of 426 mm to a maximum of 640 mm (Table 7). Sample sizes of age-sex classes 1.1 and 3.1 were not large enough to discern differences in mean length between age-sex classes and there appears to be no significant difference in length between males and females of age class 2.1 (Figure 6).

WEATHER AND STREAM OBSERVATION

Crew successfully collected weather and stream measurements twice daily between 15 June and 20 September 2008 (Appendix A2). Water level ranged between 19 and 203 cm on the staff gage, and averaged 42.1 cm over the operational period (Figure 9). Based on thermometer readings, water temperature in the Tatlawiksuk River ranged from 5.0 to 14.0°C and averaged 9.9°C over the operational period (Figure 9). Data collected from the Hobo® Water Temp Pro V2 data logger are summarized in Appendix A3. Hourly readings ranged from 6.1 to 14.6°C over the operational period, and daily stream temperature averaged 10.7°C. Stream discharge was successfully measured one time in 2008. The discharge was measured at a water level of 26 cm and the total discharge was 17.4 m^3 per second (Appendix A4).

KNA HIGH SCHOOL INTERNSHIP PROGRAM

Seventeen high school students from 7 local villages participated in the program in 2008, all of whom successfully completed their internships. The Tatlawiksuk River weir crew hosted 8 of the 17 students in the program. In addition, 3 KNA college interns worked at the Tatlawiksuk River weir from 1–3 weeks to gain experience with sampling techniques and an understanding of this type of fisheries monitoring project.

RELATED FISHERIES PROJECTS

Kuskokwim River Coho Salmon Investigations

In 2008, the Tatlawiksuk River weir crew observed 55 tagged fish (2%) of the 2,825 coho salmon tagged at Kalskag. The weir crew recovered tag information from 53 tagged fish, 6 of which were captured twice. Tagged fish were sometimes observed slipping downstream over the weir after release. The fixed tracking station at Tatlawiksuk River weir detected 12 coho salmon passing upstream of the weir, all of which were captured by the weir crew. During normal age-sex-length sampling, 661 coho salmon were examined for a cut adipose fin. No fish were observed to have the adipose fin cut and the tag missing.

Temperature Monitoring

Hobo® air and water temperature loggers were deployed on 16 June and pulled and/or downloaded on 22 September. Data loggers and data shuttle were sent to the contractor on 8 October for equipment maintenance and storage and data management and reporting.

Otolith Collection

A total of 40 chum salmon otoliths were collected from Tatlawiksuk River weir in 2008. Information regarding the collection, processing and results can be obtained from Sutton and Harris (T. Sutton, University of Alaska, Fairbanks and F. Harris, USFWS, Kenai).

DISCUSSION

ESCAPEMENT MONITORING

The 2008 field season at Tatlawiksuk River weir successfully provided reliable estimates of Chinook, chum, and coho salmon escapements. Escapement monitoring was conducted throughout most of the target operational period from 15 June to 18 September, which was consistent with past years. Salmon passage was low for several days following weir installation (Table 1), so the likelihood that many salmon passed upstream of the weir site before installation is low. Estimates of missed passage contributed a moderate portion of total estimated escapement for Chinook and chum salmon. Passage counts terminated 2 days prior to the end of the target operational period. Low passage counts in the preceding days and low estimates of coho salmon passage in the last 2 days of the target operational period indicated that the majority of coho salmon were observed passing the Tatlawiksuk River weir (Table 1).

Chinook Salmon

Abundance

Daily and total annual escapements of Chinook salmon reported at Tatlawiksuk River weir in 2008 are considered reliable based on moderate estimates of missed passage (10% of total annual escapement). These estimates primarily addressed the inoperable period from 29 June to 7 July. The small number of observed Chinook salmon prior to the inoperable period and an observed peak well after the inoperable period supported the use of the "linear method" for estimating missed passage. The small proportion of fish estimated during the inoperable period was supported by late run timing observed throughout the Kuskokwim Drainage (Elison et al. *In prep*; Miller and Harper et al. *In prep* a; Miller and Harper *In prep* b; Stewart et al. *In prep*; Williams et al. *In prep*) and the relatively low passage observed for 3 days after weir operations resumed.

The estimated escapement of 1,071 Chinook salmon in 2008 was the second lowest escapement reported at the Tatlawiksuk River weir (Figure 10); only the 2000 escapement of 810 fish was lower. Because formal escapement goals have not been established for the Tatlawiksuk River, it is difficult to asses the adequacy of the 2008 escapement. Of the 4 tributaries in the Kuskokwim River drainage with established ground-based escapement goals for Chinook salmon, only Kogrukluk River weir met its minimum goal (Williams et al. *In prep*; ADF&G 2004; Molyneaux and Brannian 2006). Generally, escapements have receded from the high years in 2004 and 2005, but have stayed above the below average levels observed in 1998–2000, as shown in Figure 10 (Bergstrom and Whitmore 2004; Molyneaux and Brannian 2006). Overall the 2008 Kuskokwim River Chinook salmon escapement was characterized as average to below average (J. C. Linderman, Jr., Commercial Fisheries Biologist, ADF&G, Anchorage; personal communication).

The commercial fishery harvest in 2008 likely had little impact on Tatlawiksuk River or on other Kuskokwim River Chinook salmon stocks. When compared to the recent 10-year average (3,287 fish), the 2008 harvest (8,865 fish) seems large. However, in the past 10 years there have been very few commercial openings prior to the beginning of August, when coho salmon-directed commercial openings typically begin. The 2008 Chinook salmon harvest is considerably lower than the historical average of 25,058 fish (1960–2007). This difference in harvest sizes is an issue of processor capacity rather than abundance (J. C. Linderman, Jr., Commercial Fisheries Biologist, ADF&G, Anchorage; personal communication). The harvest of 8,865 Chinook salmon is a relatively small harvest, especially when compared to the subsistence harvest; the commercial harvest only comprised 11% of the total commercial and subsistence harvests (J. C. Linderman, Jr., Commercial Fisheries Biologist, ADF&G, Anchorage; personal communication).

In contrast with the commercial fishery, the effect of the subsistence fishery on individual Kuskokwim River Chinook salmon stocks was probably appreciable. The total subsistence harvest for 2008 was not estimated at the time of this report. However, the annual subsistence harvest of Chinook salmon has remained relatively constant through history, despite varying abundance. Therefore, we assume the most recent 10-year average (1997–2006) of 72,277 fish probably reasonably approximates the 2008 harvest (Smith and Dull 2008), although this estimate is preliminary. The subsistence harvest and the commercial harvest add to an approximate harvest of 80,000 in 2008.

Run Timing at Weir

Based on median passage dates, the timing of the Chinook salmon run at Tatlawiksuk River weir in 2008 (17 July) was one of the latest runs on record (Figure 3; Appendix D1); only the run in 1999 had a later median passage date (Stewart et al. 2008). In 2008, the passage of the central 50% of the run extended past all other years (Figure 3). All other ground-based escapement monitoring projects in the Kuskokwim River in 2008, similarly observed runs later than those recorded previously (Elison et al. *In prep*; Miller and Harper *In prep* a; Miller and Harper *In prep* b; Stewart et al. *In prep*; Williams et al. *In prep*). The run duration of the central 50% of the run was compressed by 3 days when compared to the historical average of 13 days.

Chum Salmon

Abundance

Daily and total annual escapements of chum salmon reported at Tatlawiksuk River weir in 2008 are considered reliable based on the moderate estimates of missed passage (16% of total annual escapement). Estimates primarily addressed the inoperable period from 29 June to 7 July. The small number of observed chum salmon prior to the inoperable period and an observed peak well after the inoperable period supported the use of the “linear method” for estimating missed passage. The small proportion of fish estimated during the inoperable period was supported by late run timing observed throughout the Kuskokwim Drainage (Elison et al. *In prep*; Miller and Harper *In prep* a; Miller and Harper *In prep* b; Stewart et al. *In prep*; Williams et al. *In prep*) and the relatively low passage observed for 2 days after weir operations resumed.

The reported escapement of 30,896 chum salmon at Tatlawiksuk River weir in 2008 is slightly below the historical average escapement from 1999 to 2007 (Figure 11; Stewart et al. 2008). The historical average is skewed high because of record high estimated escapement in 2007. The escapement in 2008 is the fourth highest of the 9 years it has been reported. Because formal escapement goals have not been established at the Tatlawiksuk River weir, it is difficult to assess the adequacy of escapement. However, escapement was within the upper range of the escapement goal at Kogrukluk River weir (Williams et al. *In prep*) and exceeded the escapement goal range at Aniak River sonar (Figure 11; McEwen *In prep*). Overall chum salmon escapements to Kuskokwim River tributaries have recovered from record low levels in 1999 and 2000 to record high levels in 2005–2007 and average to below average levels in 2008 (Figure 11). George River weir was the only ground-based escapement project that reported above average chum salmon escapement in 2008.

The annual commercial harvest of chum salmon in the Kuskokwim Area has varied considerably. Prior to the poor chum runs in 1999 and 2000, the 10-year average commercial harvest was 334,029 chum salmon (Smith and Dull 2008). Closure of the chum-directed commercial fishery in 2001–2003 presumably helped restore runs to healthy levels, but poor market demand for Kuskokwim River chum salmon since the fishery was reopened in 2004 has resulted in little harvest activity. The 2008 commercial harvest of 30,516 chum salmon was 27% below the recent 10-year average of 39,272. This level of harvest probably had little impact on Tatlawiksuk and Kuskokwim River stocks and is likely inconsequential when compared to the historical average of 197,285 fish (1960–2007) (J. C. Linderman Jr., Commercial Fisheries Biologist, ADF&G, Anchorage; personal communication).

As with the commercial fishery, the effect of the subsistence fishery on individual Kuskokwim River chum salmon stocks was probably negligible. The total subsistence harvest for 2008 has not yet been estimated; however, the most recent 10-year average (1997–2006) of 52,439 fish (Smith and Dull 2008) probably reasonably approximates the 2008 harvest. The estimated total harvest was less than 85,000 fish in 2008. Compared to the escapement of 144,107 fish across all Kuskokwim River weir projects combined with the 427,911 estimated in the Aniak River via sonar (McEwen *In prep*), and an unknown number escaping to unmonitored tributaries, the total harvest of chum salmon probably did not greatly reduce tributary escapements. Healthy escapements observed in every monitored tributary support the assessment that there was a harvestable surplus of chum salmon in 2008. However, the mild to moderate processor interest and subsistence interest in this species limited exploitation (J. C. Linderman Jr., Commercial Fisheries Biologist, ADF&G, Anchorage; personal communication).

Run Timing at Weir

Based on median passage dates, the timing of the chum salmon run at Tatlawiksuk River weir in 2008 (17 July) was later than most previous years (Figure 3; Appendix D2). Historically, median passage dates have ranged from 10 July in 2002 to 18 July in 1999 and averaged 14 July (Stewart et al. 2008). Median passage dates at other Kuskokwim River chum escapement projects in 2008 were all later than most previous years as well (Elison et al. *In prep*; Miller and Harper *In prep* a; Miller and Harper *In prep* b; Stewart et al. *In prep*; Williams et al. *In prep*). The central 50% of the run occurred over a 12 day period in 2008, which is slightly less than the historical average at Tatlawiksuk River weir.

Coho Salmon

Abundance

Daily and total annual escapement estimates of coho salmon reported at Tatlawiksuk River weir in 2008 are considered reliable because estimates for missed passage constituted less than 1% of the total annual escapement reported (Table 1). Estimates addressed the early termination of weir operations. Passage trends (Table 1) and historical run timing (Figure 3; Appendix D3) indicate that a small portion of coho salmon passed after termination of weir operations. Decreasing passage counts supported the use of the "exponential method" for estimating the remaining passage for the target operational period (Table 1; Figure 12).

The escapement of 11,065 coho salmon in 2008 was higher than most previous years at Tatlawiksuk River weir, which ranged between 3,455 in 1999 and 16,410 in 2004 (Figure 13; Stewart et al. 2008). Because formal escapement goals have not been established for the Tatlawiksuk River, it is difficult to assess the adequacy of the escapement. Kogrukluk River weir is the only project in the Kuskokwim drainage that has an escapement goal for coho salmon (Molyneaux and Brannian 2006). The escapement at Kogrukluk River exceeded the current escapement goal upper boundary (Williams et al. *In prep*). Escapements at all other ground based escapement monitoring projects throughout the drainage were above average with the exception of Tuluksak and Takotna River weirs where escapements were below average (Elison et al. *In prep*; Miller and Harper *In prep* a; Miller and Harper *In prep* b; Stewart et al. *In prep*; Williams et al. *In prep*).

Commercial harvest pressure on Kuskokwim River coho salmon has historically been considerable. Though the commercial harvest of 142,862 coho salmon in 2008 was probably large enough to noticeably reduce observed escapements at tributary weirs, it was 22% below the most recent 10-year average harvests (J. C. Linderman, Jr., Commercial Fisheries Biologist, ADF&G, Anchorage; personal communication). The completion of a study entitled *Kuskokwim River Coho Salmon Investigation* will provide a greater understanding of exploitation through annual inriver abundance estimates (Toshihide Hamazaki, Commercial Fisheries Biometrician, ADF&G, Anchorage; personal communication).

Estimates are not yet available for the 2008 subsistence harvest, but the preliminary 1997–2006 average harvest estimate of 30,427 fish (Smith and Dull 2008) is probably a reasonable approximation because annual subsistence harvests have not varied greatly in the past 10 years of available data. Compared to the number of coho salmon captured in the commercial fishery, and recognizing that escapements were near average to high, a subsistence harvest of approximately 30,000 coho salmon likely did not considerably impact escapements of individual stocks.

Run Timing at Weir

Based on the median passage date, the timing of the coho salmon run at Tatlawiksuk River weir in 2008 (19 August) was earlier than most previous years (Figure 3; Appendix D3). Median passage dates in previous years ranged from 18 August in 2007 to 2 September in 1999 (Stewart et al. 2008). Median passage dates at other Kuskokwim River coho escapement projects in 2008 were variable. Kogrukluk and Kwethluk River weirs had near average median passage dates, Tuluksak and George River weirs had earlier than average median passage dates, and Takotna River weir had later than average median passage dates (Elison et al. *In prep*; Miller and Harper *In prep* a; Miller and Harper *In prep* b; Stewart et al. *In prep*; Williams et al. *In prep*). The central 50% of the run occurred over a 12 day period in 2008, which is slightly less than the historical average at Tatlawiksuk River weir (Figure 3).

Other Species

Sockeye Salmon

Few sockeye salmon are observed in the Tatlawiksuk River, and the reported escapement of 39 sockeye salmon in 2008 was typical for this species. Due to low escapements, sockeye salmon passage is not estimated at this location. Annual sockeye salmon escapements at the Tatlawiksuk

River weir have ranged from zero fish in 2000 to 77 fish in 2005 (Stewart et al. 2008). In 2008, Kwethluk and Kogrukluk River weirs, which receive considerably higher sockeye salmon escapements, observed above average escapements (Figure 14; Miller and Harper *In prep* a; Williams et al. *In prep*). Sockeye salmon are not generally abundant in the Kuskokwim River, and they are not prominent in subsistence and commercial harvests. Comparatively little is known about sockeye salmon in the Kuskokwim River and escapement goals have not been established.

Historical run timing comparisons are limited by low abundances at Tatlawiksuk River weir, but available data indicate spawning migrations occur primarily between late July and mid August (Stewart et al. 2008). Similar run timing has been observed at George and Takotna weirs (Costello et al. 2008; Thalhauser et al. 2008). General run timing is considerably earlier at Kwethluk and Kogrukluk River weirs, but in 2008 these runs were approximately one week later than average (Miller and Harper *In prep* a; Williams et al. *In prep*). Sockeye migrations generally peak in early July at Kwethluk and mid July at Kogrukluk River weirs (Miller and Harper 2008; Williams et al. *In prep*).

Pink Salmon

Pink salmon are occasionally observed in the Tatlawiksuk River, but only in small numbers. A total of 19 pink salmon were observed at the Tatlawiksuk River weir in 2008, where counts have historically ranged from 0 to 20 fish (Stewart et al. 2008). The Tatlawiksuk River is not a primary spawning tributary for pink salmon; therefore, it is not surprising that few pink salmon were observed in 2008 relative to other tributaries such as the Kogrukluk River (Williams et al. *In prep*).

Non-Salmon Species

Longnose suckers are historically the most abundant non-salmon species counted at the Tatlawiksuk River weir. Passage counts of longnose suckers are not meant to represent actual abundance because smaller individuals are able to pass through the pickets freely and migration timing typically precedes weir installation (Stewart et al. 2008). Counts are recorded to serve as a broad index for monitoring resident populations and species that occur at Tatlawiksuk River.

Upstream passage of longnose suckers in 2008 was observed mostly during June (Appendix B1). This was typical of what has been observed in most years. Since weir operations began in 1998, Longnose sucker counts have ranged from 75 fish in 2004 to 5,093 fish in 1999 (Stewart et al. 2008). The count of 3,385 longnose suckers in 2008 is second highest observed passage since 1998. Similar to previous years, small numbers of whitefish, Northern pike, and Arctic Grayling passed upstream sporadically throughout the season (Appendix B1).

Carcasses

Carcass counts do not provide a complete census of carcass load at Tatlawiksuk River weir. The installation of downstream passage chutes in late summer, to accommodate longnose sucker and whitefish species, provides a pathway for post-spawn salmon and carcasses to pass uncounted. Daily carcass counts may noticeably decrease following chute installation (Appendix C1). Also, the weir was removed long before coho salmon had completed spawning, so a reasonable estimate of coho salmon carcass load at the weir cannot be determined. Despite these confounding factors, it is believed a majority of Chinook and chum carcasses passing downstream of the weir are counted. The proportion of Chinook and chum escapements counted as carcasses at the weir in 2008 was 2.1% and 4.6% respectively. These small proportions indicate most of the carcasses were retained within the Tatlawiksuk River drainage throughout the season, thereby contributing to the productivity of the system through the addition of marine derived nutrients as described by Cederholm et al. (1999; 2000).

The use of carcass counts in analyses to estimate stream life in the Tatlawiksuk River has been discounted by Linderman et al. (2003), and is no longer considered. Additionally, weir carcass counts are generally biased low for females (DuBois and Molyneaux 2000), and are not employed to estimate sex composition of escapements.

AGE, SEX, AND LENGTH COMPOSITION

Chinook Salmon

The 93 aged samples (8.7% of escapement) were generally well distributed throughout the run and were adequate to estimate ASL composition of total annual escapement in 2008 (Tables 2 and 3). ASL composition has been estimated in 6 of 11 years the project has operated. Flood damage precluded estimates of escapement in 1998 and 2003. Small sample sizes precluded estimates of ASL composition in 1999, 2000, and 2001.

Age Composition

The predominance of age-1.2, -1.3, and -1.4 classes in 2008 is similar to past years at Tatlawiksuk River, and similar to what has been observed elsewhere in the Kuskokwim Area (Molyneaux et al. 2008). Age-1.5 fish were absent from the 2008 sample. This age composition differed from previous years in that there was a lower percentage of age-1.2 fish and a higher percentage of age-1.3 fish, but the percentage of age-1.4 fish remained near average (Figure 4). Considering the relatively low escapement in 2008, the abundance of age-1.2 fish were well below all previous years while age-1.3 and -1.4 fish were near the historical low escapement (Figure 15). Appendix E1 provides a brood table for the available Tatlawiksuk River data, but the information is not yet complete enough to assess sibling relationships and cohort strength. Sibling relationships are the idea that abundance of an age-class in one year can predict the abundance of their siblings the next year (one year older). Additionally, these data do not account for the fraction of Tatlawiksuk River fish taken in the harvest that occurs downstream of the weir.

The age composition at Tatlawiksuk River weir was consistent with all other escapement projects with the exception of Kogrukluk River weir (Elison et al. *In prep*; Miller and Harper *In prep* a; Miller and Harper *In prep* b; Stewart et al. *In prep*; Williams et al. *In prep*). Kogrukluk River weir saw a relatively high percentage of age-1.2 fish, while all other projects observed a relatively low percentage of age-1.2 fish compared to historical averages. Even though similar age composition was consistent across all other projects, there was variability in how these projects compared to their respective historical average. One thing that was consistent among all projects was that the percentage of age-1.3 fish was higher than most previous years. This was not surprising because there was a high percentage of age-1.2 fish reported throughout the Kuskokwim Drainage in 2007 (Costello et al. 2008; Miller and Harper 2008; McEwen 2009; Plumb and Harper 2008; Thalhauser et al. 2008; Williams et al.2008). Another consistency among most escapement projects was the relatively low percentage of age-1.4 fish, but this was not seen at Tatlawiksuk River. A relatively low percentage of age-1.4 fish could suggest that the subsistence fishery affected the Kuskokwim River Chinook salmon stocks, while the commercial fishery had negligible impact. The commercial fishery, which is restricted to 6 inch mesh, targets the smaller and thus younger fish, but the subsistence fishery generally utilizes 8 inch mesh, which targets larger and thus older fish (Molyneaux et al. 2008).

Although sample sizes are generally too small at the Tatlawiksuk River weir to depict significant variations in age composition over the Chinook salmon run, combining these data with past years may indicate trends that might otherwise be ignored (Figure 4). Patterns are unclear for age-1.3 and -1.4 fish, but age-1.2 fish appear to migrate earlier in proportion to the other age classes.

Sex Composition

The abundance of female Chinook salmon in the 2008 escapement was the lowest of 6 years reported at Tatlawiksuk River weir, but the total percent composition of females (39%) was the second highest reported. The total percent composition of females has ranged from a minimum of 27% in 2007 to a maximum of 41% in 2006 (Figure 16). The abundance of females has ranged from a high of 1,242 females in 2005 to this year's low of 418 females. The low abundance, but relatively high composition of females are evident because the age-1.2 fish had a poor return in 2008 (Figure 16). Percent composition of females in each age class differ greatly and can be calculated from Table 2 by dividing the total number of fish in an age class by the total number of females in that age class and multiply by 100. Females comprised about 8% of age-1.2 fish, 31% of age-1.3 fish, and 62% of age-1.4 fish, in 2008. The percent composition of females at age-1.3 and 1.4 was near average. This pattern of low percent female composition is similar to previous years at the Tatlawiksuk River weir, and was typical of Chinook salmon throughout the Kuskokwim River drainage in 2008 (Molyneaux et al. 2008).

The record low reported female escapement of only 418 fish into Tatlawiksuk River in 2008 may be cause for some concern, although limited data of spawner-recruit relationships at Tatlawiksuk River indicate that this population has the ability to rebound from poor escapements as was seen with the 2000 brood year (Appendix E1). Unfortunately, these data do not include the actual numbers of females in 2000 and 2001 so relationships have to be surmised from total escapement. Several more years of data are needed at Tatlawiksuk River before the response to variation in escapement can be determined.

Although sample sizes may sometimes be too small at Tatlawiksuk River weir to depict significant variations in sex composition over the Chinook salmon run, combining these data with past years may indicate trends that might otherwise be ignored. Figure 5 reveals a consistent pattern in the percentage of female Chinook salmon increasing over the run at the Tatlawiksuk River weir. This type of pattern may have implications for how harvest affects escapement.

Length Composition

Mean lengths for each age-sex category in 2008 were generally similar to previous years (Figure 17). Mean length tended to increase with age, and females tended to be longer than males of the same age (Figure 6), which is a pattern commonly observed in Chinook salmon throughout the Kuskokwim River drainage (Molyneaux et al. 2008).

Management Implications

Salmon are harvested in both subsistence and commercial fisheries that occur in the mainstem Kuskokwim River far downstream from the Tatlawiksuk River and other spawning areas (Whitmore et al. 2008). Most harvest is taken with gillnets that are size selective for discreet components of the returning salmon population. The potential impact of the size selective harvest is perhaps most consequential to Chinook salmon because of their wide range of size at maturity.

Subsistence fishermen tend to favor using gillnets hung with large mesh web (e.g., 8 in stretch mesh; Smith and Dull 2008), so harvest is selective for the larger and older Chinook salmon (Molyneaux et al. 2008). This is the same segment of the population where females are most common. Timing of the subsistence harvest tends to be weighted towards the early part of the run, which is when stocks with more distant spawning grounds such as Tatlawiksuk River are likely to be the most concentrated. However, the degree of overlap in stock-specific run timings tends to be broad for Chinook salmon (Pawluk et al. 2006). The exploitation rate of the subsistence fishery was estimated to range between 22% and 32% of the total Kuskokwim River Chinook salmon runs in the years 2002, 2003, 2004, and 2005 (Molyneaux and Brannian 2006).

In contrast, commercial fishermen are limited to using 6 in or smaller mesh sizes (Whitmore et al. 2008), so harvest is selective for smaller Chinook salmon in a size range dominated more by males. The timing of the commercial fishery tends to be more towards the second half of the Chinook salmon run; however, in recent years the low market interest has resulted in very limited commercial harvest. Exploitation rate from the commercial fishery are estimated to have been no more than 1.6% in the 2002 to 2005 run reconstructions (Molyneaux and Brannian 2006).

The Chinook salmon seen at Tatlawiksuk River weir and spawning grounds elsewhere in the Kuskokwim River consist of the fraction of fish that escape harvest. The selectivity of that harvest influences the resulting age, sex, and length composition in the escapement. Most of the Chinook salmon harvest in 2008 occurred in the subsistence fishery. The size selection of the prevalent subsistence harvest practices, in concert with the relatively high exploitation rate of the subsistence fishery, may have increased both the prevalence of smaller male Chinook salmon and the scarcity of larger fish and females in the escapement. This may have amplified the high proportion of young male to older female Chinook salmon observed in the Kuskokwim River drainage. While this trend was not apparent at Tatlawiksuk River it was apparent at Kogrukluk River, which is likely a better indicator of overall Chinook salmon escapement in the Kuskokwim River drainage (J. C. Linderman Jr., Commercial Fisheries Biologist, ADF&G, Anchorage; personal communication).

Chum Salmon

The 799 aged chum salmon samples (2.6% of escapement) were well distributed throughout the run and were adequate to estimate the ASL composition of total annual escapement in 2008 (Tables 4 and 5). ASL composition has been estimated in 9 of 11 years the project has operated. Flood damage precluded estimations in 1998 and 2003.

Age Composition

Chum salmon return to the Kuskokwim Area at age-0.2, -0.3, -0.4, and -0.5, with age-0.3 and -0.4 predominant (Molyneaux et al. 2008). Similar age distribution has been observed historically in chum salmon escapements to the Tatlawiksuk River (Stewart et al. 2008). In 2008, the chum salmon escapement was dominated by age-0.4 fish (76%; Table 4). This reflects the record escapement at Tatlawiksuk River in 2007, dominated by age-0.3 fish (80%; Stewart et al. 2008). This pattern, with the 2003 brood year dominating the run as age-0.3 fish in 2007 and as age-0.4 fish in 2008, was apparent at Kwethluk River, Tuluksak River, Aniak River sonar, George River, and Takotna River (Elison et al. *In prep*; McEwen *In prep*; Miller and Harper *In prep* a; Miller and Harper *In prep* b; Stewart et al. *In prep*). Kogrukluk River was the only escapement project that did not exhibit this pattern (Williams et al. *In prep*). Chum salmon escapement was not enumerated at Tatlawiksuk River in 2003, but most other escapement projects in the Kuskokwim River drainage had above average escapements. While the abundance of age-0.4 fish was high in 2008 the abundance of age-0.3 and -0.2 fish was low relative to previous years (Figure 15). If sibling relationships are any indication then this may be predictive of a below average escapement of age-0.3 and -0.4 fish in 2009 at Tatlawiksuk River and elsewhere (Appendix E2).

Changes in age composition over the chum salmon run are subtle and may not appear significant in any given year. However, pooling age data with past years may indicate trends that might otherwise be ignored. Figure 7 shows a tendency in the percentage of age-0.4 fish to decrease over the run and a tendency in the percentage of age-0.2 and 0.3 fish to increase toward the end of the run at Tatlawiksuk River weir. The pattern of decreasing age over the course of the run appears to be common for chum salmon populations in the Kuskokwim Area and elsewhere (Molyneaux et al. 2008).

Sex Composition

Female fish accounted for 52% of the 2008 chum salmon escapement and was similar to previous years at the Tatlawiksuk River weir, which has ranged from 39% in 2004 to 58% in 2005 and averaged 49% annually (Figure 16). The abundance of 16,146 female chum salmon in 2008 is near the historical average escapement, which has ranged from a low of 3,359 in 2000 to a high of 43,540 in 2007 (Figure 16). As with the Tatlawiksuk River weir, other escapement project in the Kuskokwim River drainage reported female compositions similar to previous years and they generally follow the trend of a one to one sex ratio (Elison et al. *In prep*; McEwen *In prep*; Miller and Harper *In prep* a; Miller and Harper *In prep* b; Stewart et al. *In prep*; Williams et al. *In prep*).

The apparent increase in the ratio of females over the run is similar to previous years at Tatlawiksuk River weir (Figure 5). This increase was expected as male chum salmon typically migrate earlier to the spawning grounds than females in the Kuskokwim Area (Molyneaux et al. 2008). This trend was also observed at George River weir in 2008 (Stewart et al. *In prep*). Kogrukluk River weir, which typically does not show this pattern did not do so in 2008 either, but this may be a function of the location Kogrukluk River weir within the Holitna River drainage (Williams et al. *In prep*).

Length Composition

Similar to 2007, mean length-at-age for both male and female chum salmon was lower in 2008 than in most previous years at Tatlawiksuk River weir (Figure 18). Results from other Kuskokwim River escapement projects indicated this was a widespread occurrence (Elison et al. *In prep*; McEwen *In prep*; Miller and Harper *In prep* a; Miller and Harper *In prep* b; Stewart et al. *In prep*; Williams et al. *In prep*).

The mean length of fish in each age-sex category tended to decrease as the 2008 season progressed (Figure 19). Males were longer at-age than females and there was an increase in mean length-at-age for male and female fish (Figure 6). These patterns are typical for chum salmon at Tatlawiksuk River weir and elsewhere in the Kuskokwim River drainage (Molyneaux et al. 2008; Stewart et al. 2008).

Coho Salmon

The 485 aged coho salmon samples (5.5% of the annual escapement) were generally well distributed throughout the run and were adequate to estimate ASL composition of the total annual escapement in 2008. ASL composition has been estimated in 7 of 11 years Tatlawiksuk River weir has operated. High water precluded estimates in 1998, 2000, 2003, and 2006.

Age Composition

Coho salmon return to the Tatlawiksuk River at age-1.1, -2.1, and -3.1, but predominantly at age-2.1. Similar age composition occurs throughout the Kuskokwim Area (Molyneaux et al. 2008). At 84.3% of escapement, the percentage of age-2.1 fish in 2008 was similar to previous years at Tatlawiksuk River weir, which ranged from 79.1% in 1999 to 94.4% in 2004, and historically averaged 88.7% (Figure 15). In 2008, age-3.1 fish comprised 11.9% of annual escapement and age-1.1 fish comprised 3.8% (Table 6). Other Kuskokwim River escapement projects reported the percentage of age-2.1 coho salmon in 2008 to be between 63.4% at George River weir and 92.8% at Tuluksak River weir (Elison et al. *In prep*; Miller and Harper *In prep* a; Miller and Harper *In prep* b; Stewart et al. *In prep*; Williams et al. *In prep*). Although it is not apparent in other years, in 2008 the percentage of age-2.1 fish decreased throughout the run as the percentage of age-3.1 fish increased (Figure 8). Kogrukluk and George River weirs saw a similar trend (Stewart et al. *In prep*; Williams et al. *In prep*).

Sibling relationships have limited utility when applied to coho salmon at Tatlawiksuk River weir for three reasons. First, nearly all Kuskokwim River coho return as age-2.1 individuals, so deviations in the abundance of other age-classes will have little effect on total annual escapement. Second, historical data at Tatlawiksuk River weir are insufficient for such analysis (Figure 15; Appendix E3). Furthermore, the total return of the Tatlawiksuk River stock cannot be determined because it is not known how many Tatlawiksuk River coho salmon are harvested in downstream fisheries.

Sex Composition

In 2008, the annual percentage of female coho salmon was 53%; which is the highest reported for the Tatlawiksuk River, but not far from the historical range (Figure 16). The annual percent composition has been as low as 39% in 2002 and historically averages 48% female. With a relatively strong total escapement in 2008 and a high percentage of females, there was the second highest abundance of females reported escaping to the Tatlawiksuk River (Figure 16). In 2008, the annual percentage of females at other Kuskokwim River escapement projects was similar to Tatlawiksuk River with the exception of Tuluksak River weir, which only reported 38% females. Female abundance followed a similar trend with most Kuskokwim River escapement projects reporting average to above average escapements and Tuluksak River weir reporting below average escapements (Elison et al. *In prep*; Miller and Harper *In prep* a; Miller and Harper *In prep* b; Stewart et al. *In prep*; Williams et al. *In prep*).

The composition of females at the Tatlawiksuk River weir was 51.8%, 51.1%, and 61.2% for the first, second, and third strata, respectively (Table 6; Figure 5). It is typical at Tatlawiksuk River for females to tend to slightly increase towards the later portions of the run. This was seen at most other Kuskokwim River escapement projects in 2008 (Elison et al. *In prep*; Miller and Harper *In prep* a; Miller and Harper *In prep* b; Stewart et al. *In prep*; Williams et al. *In prep*) and is typical of coho salmon in the Kuskokwim Area (Molyneaux et al. 2008).

Length Composition

Because coho salmon are predominately age-2.1 fish, length samples for other age classes are generally too few for consideration. Males and females age-2.1 were shorter in 2008 than in most previous years (Figure 20). In the total weighted sample, mean length-at-age-2.1 was not different between male and female coho salmon (Figure 6). Similar results were reported at George, Takotna, and Kogrukluk River weirs in 2008 as well (Elison et al. *In prep*; Stewart et al. *In prep*; Williams et al. *In prep*). Though not readily apparent in most previous years at Tatlawiksuk River weir, Molyneaux et al. (2008) indicate a tendency for length-at-age to be greater for female coho salmon than for males.

WEATHER AND STREAM OBSERVATION

Water levels were low for the first 2 weeks of weir operations then dramatically rose 175 cm over a 4 day period. This high water event rendered the weir inoperable for a 9 day period during the early part of the Chinook and chum salmon runs in 2008. Water levels receded to below average levels for the remainder of the season and record low water levels were observed from the end of August until the termination of weir operations (Figure 9). Water temperatures were generally near average throughout the season with the exception of the high water event when water temperatures dropped well below average (Figure 9).

One discharge measurement was completed in 2008, so comparison of a range of flows to the measured stage in not possible. In 2005, four discharge measurements were taken at several stages ranging from 15 cm to 100 cm, which resulted in a stage-to-discharge relationship (Figure 21; Costello et al. 2006). The measured discharge in 2008 of 17.4 m^3/s at a stage of 26 cm is consistent with the stage discharge relationship from 2005. Assuming the channel morphology has not changed significantly we can apply the recorded stage measurements from 2008 to the stage discharge relationship from 2005. Using this method, flows at the Tatlawiksuk River weir during the target operational period in 2008 ranged from a minimum of 16 m^3/s to a maximum 425 m^3/s and averaged 33.9 m^3/s. Collection of discharge measurements at a range of flows at Tatlawiksuk River should be continued into the future to build a comprehensive historical data set.

The 2 methods for determining morning water temperature at the Tatlawiksuk River weir yielded similar results in 2008 (Figure 22). Daily morning water temperatures derived from both methods paralleled each other for parts of the season, but not throughout the whole season. Observed differences are attributed to slightly different methods used by different crew members while collecting temperature. Generally the daily morning water temperature determined from thermometer measurements was about 1° to 2°C cooler, on average, than the reading recorded by the Hobo® Water Temp Pro data logger around the same time (Figure 22). This was probably the result of the thermometer taking temperature readings along the stream margin where colder water may have been seeping through the gravel beneath the bank. The data logger was likely more accurate as it was tethered to the stream bottom near mid channel. Use of the data logger to generate summaries of daily minimum, maximum and average stream temperatures should be continued in future years to build a more comprehensive historical data set.

Knowledge of environmental conditions and a commitment to long-term monitoring may be valuable in understanding migration and survival. Quinn (2005) notes that migration in salmon is probably controlled by genetic factors as an adaptation to long-term average environmental conditions. Keefer et al. (2004) found a positive correlation between river discharge and run timing of Columbia River Chinook salmon stocks, and that Columbia River sockeye salmon have started their inriver migration 2 weeks earlier in response to warmer water conditions resulting from dam construction. We cannot begin to assess the effects of changing environmental conditions on Kuskokwim River salmon without the relatively complete weather and stream observations collected by weir crews such as at the Tatlawiksuk River. Escapement projects must continue to be diligent in the collection of weather and stream data. Perhaps with sufficient data, researchers and managers will be able to assess relationships between migration and environmental factors relevant in the broader spatial-temporal context.

KNA High School Internship Program

Since 1998 KNA, with funding from the USFWS Partners for Fisheries Resource Monitoring Program, has provided 161 internships to local area high school students at fisheries projects operated cooperatively with ADF&G. A number of students have subsequently been employed by KNA and ADF&G as technicians at these same projects (Hildebrand and Orabutt 2007). These internships benefit both students and the projects that host them. Interns gain exposure to fisheries monitoring projects and the employment opportunities associated with them. The projects gain a much needed level of community involvement, which the authors believe contributes to continued local support of the research and management structure that they support.

Related Fisheries Projects

Kuskokwim River Coho Salmon Investigations

At the time of publication, the mark–recapture study was still in progress; additionally the development of the model required for a comprehensive run reconstruction is ongoing. Results and discussion of success will be reported in a separate publication that will be written upon completion (K. L. Schaberg, Commercial Fisheries Biologist, ADF&G, Anchorage; personal communication).

CONCLUSIONS

Chinook Salmon

- The escapement of 1,071 Chinook salmon in 2008 was the second lowest reported at Tatlawiksuk River weir.
- The run was later in 2008 than almost all previous years.
- The relatively high abundance of age-1.3 fish reflected the relatively strong return on age-1.2 fish in 2007.
- 2008 had the fewest returning females of all years reported at Tatlawiksuk River weir.
- Mean lengths for each age-sex category in 2008 were generally similar to previous years.

Chum Salmon

- The reported escapement of 30,896 chum salmon at Tatlawiksuk River weir in 2008 is slightly below the historical average escapement.
- The run was later in 2008 than most previous years.

- The escapement at Tatlawiksuk River weir in 2008 was dominated by age-0.4 fish, which reflects the high escapement of age-0.3 fish in 2007.
- Mean lengths were generally less in 2008 than in most previous years at Tatlawiksuk River and throughout the Kuskokwim River drainage.

COHO SALMON

- The escapement of 11,065 coho salmon in 2008 was above the historical average at Tatlawiksuk River weir.
- The run was earlier in 2008 than most previous years.
- Coho salmon return at age-1.1, -2.1, and -3.1; as in all previous years the return was dominated by age-2.1 fish.
- Mean lengths were generally shorter in 2008 than in most previous years at Tatlawiksuk River.

WEATHER AND STREAM OBSERVATIONS

- Water levels were generally below average, with the exception of a high water event that rendered the weir inoperable for a 9 day period during the early part of the Chinook and Chum salmon run.
- Water temperatures remained within the historical range throughout most of the season.

ACKNOWLEDGMENTS

The Tatlawiksuk River weir project is operated cooperatively by KNA and ADF&G, Division of Commercial Fisheries. The USFWS, Office of Subsistence Management, provided $161,777 in 2008 for this project through the Fisheries Resource Monitoring Program (FRMP), under agreement numbers 701817J647 and 701817C298, with matching support from the State of Alaska and KNA. Additionally, FRMP helps fund salmon age, sex, and length data analysis for this and many other projects in the Kuskokwim Area under agreement number 701817J646, and provides a KNA biologist position through its Partners Program in support of this and other projects under agreement number 701812J479. Operational funds have been provided to KNA from a number of sources including grants from the National Fish and Wildlife Foundation, and grants from the U.S. Bureau of Indian Affairs administered by the Bering Sea Fishermen's Association (BSFA). The Tatlawiksuk River weir was initiated under a grant from the Western Alaska Disaster Relief Program under the National Oceanic and Atmospheric Administration. Other groups such as the Kuskokwim Corporation and the ADF&G Division of Sport Fish have provided in-kind support to the project in the form of free land use for camp facilities, weir fabrication, and welding services. General Fund support from ADF&G included assistance from staff biologists, fish and wildlife technicians who serve as crew leaders or crew members, and some operational costs.

Many individuals contributed to the operation of the Tatlawiksuk River weir in 2008. Thanks to Ashley Fairbanks of ADF&G, and David Orabutt, Mike Thalhauser, Tamara Sakar, Samantha John, and Calvin Simeon of KNA, for administrative and logistical support. Thanks also to KNA crew members Mike Sakar and Mark VanFleteren, KNA college interns Rochelle Sakar and Alex Nicori and high school interns Wendy Parent, Barbra Waskey, Jenna Ward, Lynn

Church, Brad Gusty, Robert Gusty, Charlotte Phillips, Lewis Phillips, and Justin Sakar for contributing to the successful project in 2008. We especially thank the Gregory family of Sinka's Landing for providing winter storage facilities and many hours of Alaskan hospitality.

REFERENCES CITED

ADF&G (Alaska Department of Fish and Game). 1998. Catalog of waters important for spawning, rearing or migration of anadromous fishes, Interior region resource management. Alaska Department of Fish and Game, Habitat Division, Juneau.

ADF&G (Alaska Department of Fish and Game). 2004. Escapement goal review of select AYK Region salmon stocks. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Informational Report 3A04-01, Anchorage. http://www.sf.adfg.state.ak.us/FedAidpdfs/RIR.3A.2004.01.pdf

Bergstrom, D. J., and C. Whitmore. 2004. Kuskokwim River Chinook and chum salmon stock status and action plan, a report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Informational Report 3A04-02, Anchorage. http://www.sf.adfg.state.ak.us/FedAidpdfs/RIR.3A.2004.02.pdf

Brannian, L. K., K. R. Kamletz, H. A. Krenz, S. StClair, and C. Lawn. 2006. Development of the Arctic-Yukon-Kuskokwim salmon database management system through June 30, 2006. Alaska Department of Fish and Game, Special Publication No. 06-21, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/sp06-21.pdf

Bromaghin, J. F. 1993. Sample size determination for interval estimation of multinomial probabilities. The American Statistician 47(3):203-206.

Brown, C. M. 1983. Alaska's Kuskokwim River region: a history, (draft). Bureau of Land Management, Anchorage.

Buklis, L. S. 1999. A description of economic changes in commercial salmon fisheries in a region of mixed subsistence and market economies. Arctic 52(1):40-48.

Burkey, C. Jr., and P. Salomone. 1999. Kuskokwim Area salmon escapement observation catalog, 1984-1998. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A99-11, Anchorage. http://www.sf.adfg.state.ak.us/FedAidpdfs/RIR.3A.1999.11.pdf

Burkey, C. Jr., M. Coffing, D. B. Molyneaux and P. Salomone. 2000a. Kuskokwim River Chinook salmon stock status and development of management/action plan options, report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A00-40, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/RIR.3A2000.40.pdf

Cederholm, C. J., M. D. Kunze, T. Murota and A. Sibatani. 1999. Pacific salmon carcasses: essential contributions of nutrients and energy for aquatic and terrestrial ecosystems. Fisheries 24(10):6-15.

Cederholm, C. J., D. H. Johnson, R. E. Bilby, L. G. Dominguez, A. M. Garrett, W. H. Graeber, E. L. Greda, M. D. Kunze, B. G. Marcot, J. F. Palmisano, W. G. Pearcy, C. A. Simenstad, and P. C. Trotter. 2000. Pacific salmon and wildlife–ecological contexts, relationships, and implications for management. Special Edition Technical Report, Prepared for D.H. Johnson and T.A. O'Neil (Mang. Dirs.). Wildlife-Habitat Relationships in Oregon and Washington. Washington Department of Fish and Wildlife, Olympia.

Coffing, M. 1991. Kwethluk subsistence: contemporary land use patterns, wild resource harvest and use, and the subsistence economy of a lower Kuskokwim River area community. Alaska Department of Fish and Game, Division of Subsistence, Technical Paper No. 157, Bethel.

Coffing, M., L. Brown, G. Jennings and C. Utermohle. 2001. The subsistence harvest and use of wild resources in Akiachak, Alaska, 1998. Alaska Department of Fish and Game, Division of Subsistence, Final Project Report to U.S. Fish and Wildlife Service, Office of Subsistence Management, FIS 00-009, Juneau.

Costello, D. J., R. Stewart, D. B. Molyneaux, and D. E. Orabutt. 2006. Tatlawiksuk River salmon studies, 2005. Alaska Department of Fish and Game, Fishery Data Series No. 06-28, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds06-28.pdf

Costello, D. J., R. Stewart, D. B. Molyneaux, and D. E. Orabutt. 2007. Tatlawiksuk River salmon studies, 2006. Alaska Department of Fish and Game, Fishery Data Series No. 07-56, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds07-56.pdf

Costello, D. J., D. B. Molyneaux, and C. Goods. 2008. Takotna River salmon studies, 2007. Alaska Department of Fish and Game, Fishery Data Series No. 08-38, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds08-38.pdf

DuBois, L., and D. B. Molyneaux. 2000. Salmon age, sex, and length catalog for the Kuskokwim Area, 1999 Progress Report. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A00-18, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/RIR.3A.2000.18.pdf

Elison, T. B., D. L. Williams, and C. Goods. *In prep*. Takotna River salmon studies, 2008. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.

Geiger, H. J., and R. L. Wilbur. 1990. Proceedings of the 1990 Alaska stock separation workshop. Alaska Department of Fish and Game, Division of Commercial Fisheries, Special Publication No. 2, Juneau. http://www.sf.adfg.state.ak.us/FedAidPDFs/cfsp.02.pdf

Groot, C., and L. Margolis, editors. 1991. Pacific salmon life histories. University of British Columbia Press, Vancouver, British Columbia.

Hauer, F. R., and W. R. Hill. 1996. Temperature, light and oxygen. Pages 93-106 [*In*]: F. R. Hauer and G. A. Lambert, editors. Methods in Stream Ecology. Academic Press, San Diego.

Hilborn, R., T. P. Quinn, D. E. Schindler, and D. E. Rogers. 2003. Biocomplexity and fisheries sustainability. Proceedings of the National Academy of Sciences 100(11):6564–6568.

Hildebrand H. L., and D. E. Orabutt Junior. 2007. Natural resource internship program. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program, Final Report (Study No. 04-309). Kuskokwim Native Association, Aniak, Alaska.

Holmes, R. A., and R. D. Burtkett. 1996. Salmon stewardship: Alaska's perspective. Fisheries 21(10):36-38.

INPFC (International North Pacific Fisheries Commission). 1963. Annual report, 1961. International North Pacific Fisheries Commission, Vancouver, British Columbia.

Keefer, M. L., C. A. Peery, M. A. Jepson, K. R. Tolotti, and T. C. Bjornn. 2004. Stock-specific migration timing of adult spring-summer Chinook salmon in the Columbia River basin. North American Journal of Fisheries Management 24:1145-1162.

Kruse, G. H. 1998. Salmon run failures in 1997-1998: a link to anomalous ocean conditions? Alaska Fishery Research Bulletin 5(1):55-63.

Linderman, J. C. Jr., D. B. Molyneaux, L. DuBois and W. Morgan. 2002. Tatlawiksuk River weir salmon studies, 1998–2001. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A02-11, Anchorage. http://www.sf.adfg.state.ak.us/FedAidpdfs/RIR.3A.2002.11.pdf

Linderman, J. C. Jr., D. J. Cannon, and D. B. Molyneaux. 2003. Tatlawiksuk River weir salmon studies, 2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A03-16, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/RIR.3A.2003.16.pdf

McEwen, M. S. 2009. Sonar estimation of chum salmon passage in the Aniak River, 2007. Alaska Department of Fish and Game, Fishery Data Series No. 09-23, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds09-23.pdf

McEwen, M. S. *In prep*. Sonar estimation of chum salmon passage in the Aniak River, 2008. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.

Miller, S. J. and K. C. Harper. *In prep* a. Run timing and abundance of adult salmon in the Kwethluk River, Yukon Delta National Wildlife Refuge, Alaska, 2008. U.S. Fish and Wildlife Service, Kenai Fishery Resource Office, Alaska Fisheries Data Series, Kenai, Alaska.

REFERENCES CITED (Continued)

Miller, S. J. and K. C. Harper. *In prep* b. Run timing and abundance of adult salmon in the Tuluksak River, Yukon Delta National Wildlife Refuge, Alaska, 2008. U.S. Fish and Wildlife Service, Kenai Fishery Resource Office, Alaska Fisheries Data Series, Kenai, Alaska.

Molyneaux, D. M., and L. K. Brannian. 2006. Review of escapement and abundance information for Kuskokwim area salmon stocks. Alaska Department of Fish and Game, Fishery Manuscript No. 06-08, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fms06-08.pdf

Molyneaux, D. B., and D. L. Folletti. 2007. Salmon age, sex, and length catalog for the Kuskokwim Area, 2006. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A07-09, Anchorage. http://www.sf.adfg.state.ak.us/FedAidpdfs/RIR.3A.2007.09.pdf

Molyneaux, D. B., A. R. Brodersen and C. A. Shelden. *In prep*. Salmon age, sex, and length catalog for the Kuskokwim Area, 2008. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report, Anchorage.

Molyneaux, D. B., D. L. Folletti, and A. R. Brodersen. 2008. Salmon age, sex, and length catalog for the Kuskokwim Area, 2007. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A08-05, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/RIR.3A.2008.05.pdf.

Mundy, P. R. 1998. Principles and criteria for sustainable salmon management, a contribution to the development of a salmon fishery evaluation framework for the State of Alaska. Alaska Department of Fish and Game, Contract No. IHP-98-045, Anchorage.

NRC (National Research Council). 1996. Upstream: salmon and society in the Pacific Northwest, Committee on the Protection and Management of Pacific Northwest Salmonids. National Academy Press, Washington, D.C.

Orabutt, D., and D. A. Diehl. 2006. Natural Resource Internship Program. Federal Subsistence Fishery Monitoring Program, Annual Project Report No. FIS 04-309. U. S. Fish and Wildlife Service, Office of Subsistence Management, Fishery Information Services Division, Anchorage, Alaska. http://alaska.fws.gov/asm/pdf/fisheries/reports/04-3092005.pdf

Pawluk, J., J. Baumer, T. Hamazaki, and D. Orabutt. 2006. A mark-recapture study of Kuskokwim River Chinook, sockeye, chum and coho salmon, 2005. Alaska Department of Fish and Game, Fishery Data Series No. 06-54, Anchorage. http://www.sf.adfg.state.ak.us/FedAidpdfs/fds06-54.pdf

Quinn, T. P. 2005. The behavior and ecology of Pacific salmon and trout. University of Washington Press, Seattle.

Smith, E. A., and B. S. Dull. 2008. Lower Kuskokwim River inseason subsistence salmon catch monitoring, 2007. Alaska Department of Fish and Game, Fishery Management Report No. 08-75, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fmr08-75.pdf

Stewart, R. 2002. Resistance board weir panel construction manual, 2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A02-21, Anchorage. http://www.sf.adfg.state.ak.us/FedAidpdfs/RIR.3A.2002.21.pdf

Stewart, R. 2003. Techniques for installing a resistance board fish weir. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A03-26, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/RIR.3A.2003.26.pdf

Stewart, R., and D. B. Molyneaux. 2005. Tatlawiksuk River salmon studies, 2004. Alaska Department of Fish and Game, Fishery Data Series No. 05-47, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds05-47.pdf

Stewart, R., D. J. Costello, D. B. Molyneaux, and J. M. Thalhauser. 2008. Tatlawiksuk River salmon studies, 2007. Alaska Department of Fish and Game, Fishery Data Series No. 08-59, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds08-59.pdf

Stuby, L. 2007. Inriver abundance of Chinook salmon in the Kuskokwim River, 2002–2006. Alaska Department of Fish and Game, Fishery Data Series No. 07-93, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds07-93.pdf

REFERENCES CITED (Continued)

Thalhauser, J. M., D. J. Costello, R. Stewart, and D. B. Molyneaux. 2008. George River salmon studies, 2007. Alaska Department of Fish and Game, Fishery Data Series No. 08-63, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds08-63.pdf

Tobin, J. H. 1994. Construction and performance of a portable resistance board weir for counting migrating adult salmon in rivers. U.S. Fish and Wildlife Service, Kenai Fishery Resource Office, Alaska Fisheries Technical Report Number 22, Kenai, Alaska.

Ward, T. C., M. Coffing, J. L. Estensen, R. L. Fisher, and D. B. Molyneaux. 2003. Annual management report for the subsistence and commercial fisheries of the Kuskokwim Area, 2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A03-27, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/RIR.3A.2003.27.pdf

Whitmore, C., M. Martz, J. C. Linderman, R. L. Fisher and D. G. Bue. 2008. Annual management report for the subsistence and commercial fisheries of the Kuskokwim Area, 2004. Alaska Department of Fish and Game, Fishery Management Report No. 08-25, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fmr08-25.pdf

Williams, D. L.., D. J. Costello, and D. B. Molyneaux. 2008. Kogrukluk River weir salmon studies, 2007. Alaska Department of Fish and Game, Fishery Data Series No. 08-60, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds08-60.pdf

Williams, D. L. and C. A. Shelden. *In prep*. Kogrukluk River salmon studies, 2008. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.

TABLES AND FIGURES

Table 1.–Daily, cumulative, and cumulative percent passage for Chinook, chum, coho, and sockeye salmon at the Tatlawiksuk River weir, 2008.

	Chinook Salmon			Chum Salmon			Sockeye Salmon			Coho Salmon		
Date	Daily	Cum.	Percent Passage	Daily	Cum.	Percent Passage	Daily	Cum.	Percent Passage	Daily	Cum.	Percent Passage
15 Jun	0	0	0	0	0	0	0	0	0	0	0	0
16 Jun	0	0	0	2	2	0	0	0	0	0	0	0
17 Jun	0	0	0	0	2	0	0	0	0	0	0	0
18 Jun	0	0	0	0	2	0	0	0	0	0	0	0
19 Jun	0	0	0	0	2	0	0	0	0	0	0	0
20 Jun	0	0	0	0	2	0	0	0	0	0	0	0
21 Jun	0	0	0	3	5	0	0	0	0	0	0	0
22 Jun	0	0	0	5	10	0	0	0	0	0	0	0
23 Jun	0	0	0	5	15	0	0	0	0	0	0	0
24 Jun	0	0	0	7	22	0	0	0	0	0	0	0
25 Jun	0	0	0	23	45	0	0	0	0	0	0	0
26 Jun	2	2	0	35	80	0	0	0	0	0	0	0
27 Jun	0	2	0	49	129	0	0	0	0	0	0	0
28 Jun	0	2	0	0	129	0	0	0	0	0	0	0
29 Jun [a]	1	3	0	81	210	1	0	0	0	0	0	0
30 Jun [a]	2	5	0	137	347	1	0	0	0	0	0	0
1 Jul [a]	3	8	1	194	541	2	0	0	0	0	0	0
2 Jul [a]	4	12	1	250	791	3	0	0	0	0	0	0
3 Jul [a]	5	17	2	307	1,098	4	0	0	0	0	0	0
4 Jul [a]	6	23	2	363	1,461	5	0	0	0	0	0	0
5 Jul [a]	7	30	3	419	1,880	6	0	0	0	0	0	0
6 Jul [a]	7	37	3	476	2,356	8	0	0	0	0	0	0
7 Jul [a]	9	46	4	532	2,888	9	0	0	0	0	0	0
8 Jul	8	54	5	475	3,363	11	0	0	0	0	0	0
9 Jul	11	65	6	702	4,065	13	0	0	0	0	0	0
10 Jul	16	81	8	1,261	5,326	17	2	2	5	0	0	0
11 Jul	39	120	11	1,240	6,566	21	0	2	5	0	0	0
12 Jul [b]	64	184	17	1,603	8,169	26	0	2	5	0	0	0
13 Jul	51	235	22	1,808	9,977	32	0	2	5	0	0	0
14 Jul	150	385	36	2,102	12,079	39	0	2	5	0	0	0
15 Jul	67	452	42	1,211	13,290	43	0	2	5	0	0	0
16 Jul	28	480	45	1,388	14,678	48	0	2	5	0	0	0
17 Jul	57	537	50	1,492	16,170	52	0	2	5	0	0	0
18 Jul [a]	50	587	55	1,337	17,507	57	0	2	5	0	0	0
19 Jul [a]	46	633	59	1,337	18,844	61	1	3	8	0	0	0
20 Jul	22	655	61	1,047	19,891	64	0	3	8	0	0	0
21 Jul	81	736	69	1,216	21,107	68	0	3	8	0	0	0
22 Jul	46	782	73	984	22,091	72	0	3	8	0	0	0
23 Jul	34	816	76	988	23,079	75	1	4	10	0	0	0
24 Jul	26	842	79	952	24,031	78	0	4	10	3	3	0
25 Jul	48	890	83	1,106	25,137	81	0	4	10	0	3	0
26 Jul	27	917	86	701	25,838	84	0	4	10	10	13	0
27 Jul	9	926	86	388	26,226	85	2	6	15	5	18	0

-continued-

Table 1.–Page 2 of 3.

Date	Chinook Salmon Daily	Chinook Salmon Cum.	Chinook Salmon Percent Passage	Chum Salmon Daily	Chum Salmon Cum.	Chum Salmon Percent Passage	Sockeye Salmon Daily	Sockeye Salmon Cum.	Sockeye Salmon Percent Passage	Coho Salmon Daily	Coho Salmon Cum.	Coho Salmon Percent Passage
28 Jul	27	953	89	626	26,852	87	5	11	28	16	34	0
29 Jul	11	964	90	547	27,399	89	5	16	41	12	46	0
30 Jul	8	972	91	220	27,619	89	1	17	44	4	50	0
31 Jul	11	983	92	602	28,221	91	0	17	44	81	131	1
1 Aug	14	997	93	563	28,784	93	5	22	56	67	198	2
2 Aug	15	1,012	94	422	29,206	95	1	23	59	28	226	2
3 Aug	9	1,021	95	250	29,456	95	0	23	59	73	299	3
4 Aug	16	1,037	97	287	29,743	96	2	25	64	153	452	4
5 Aug	9	1,046	98	158	29,901	97	0	25	64	82	534	5
6 Aug	13	1,059	99	192	30,093	97	0	25	64	240	774	7
7 Aug	2	1,061	99	68	30,161	98	0	25	64	120	894	8
8 Aug	3	1,064	99	129	30,290	98	0	25	64	274	1,168	11
9 Aug	2	1,066	100	127	30,417	98	0	25	64	315	1,483	13
10 Aug	0	1,066	100	59	30,476	99	1	26	67	199	1,682	15
11 Aug	2	1,068	100	70	30,546	99	0	26	67	207	1,889	17
12 Aug	2	1,070	100	48	30,594	99	0	26	67	345	2,234	20
13 Aug	0	1,070	100	34	30,628	99	1	27	69	157	2,391	22
14 Aug	0	1,070	100	46	30,674	99	2	29	74	336	2,727	25
15 Aug	0	1,070	100	31	30,705	99	1	30	77	540	3,267	30
16 Aug	0	1,070	100	28	30,733	99	2	32	82	547	3,814	34
17 Aug	0	1,070	100	34	30,767	100	1	33	85	634	4,448	40
18 Aug	0	1,070	100	30	30,797	100	4	37	95	680	5,128	46
19 Aug	0	1,070	100	5	30,802	100	0	37	95	493	5,621	51
20 Aug	0	1,070	100	11	30,813	100	0	37	95	697	6,318	57
21 Aug	0	1,070	100	16	30,829	100	0	37	95	502	6,820	62
22 Aug	0	1,070	100	2	30,831	100	0	37	95	515	7,335	66
23 Aug	0	1,070	100	6	30,837	100	0	37	95	349	7,684	69
24 Aug	0	1,070	100	7	30,844	100	0	37	95	353	8,037	73
25 Aug	1	1,071	100	9	30,853	100	1	38	97	303	8,340	75
26 Aug	0	1,071	100	4	30,857	100	0	38	97	240	8,580	78
27 Aug	0	1,071	100	2	30,859	100	0	38	97	323	8,903	80
28 Aug	0	1,071	100	4	30,863	100	1	39	100	299	9,202	83
29 Aug	0	1,071	100	4	30,867	100	0	39	100	144	9,346	84
30 Aug	0	1,071	100	0	30,867	100	0	39	100	204	9,550	86
31 Aug	0	1,071	100	8	30,875	100	0	39	100	204	9,754	88
1 Sep	0	1,071	100	4	30,879	100	0	39	100	109	9,863	89
2 Sep	0	1,071	100	5	30,884	100	0	39	100	95	9,958	90
3 Sep	0	1,071	100	0	30,884	100	0	39	100	130	10,088	91
4 Sep	0	1,071	100	4	30,888	100	0	39	100	75	10,163	92
5 Sep	0	1,071	100	1	30,889	100	0	39	100	134	10,297	93
6 Sep	0	1,071	100	1	30,890	100	0	39	100	85	10,382	94
7 Sep	0	1,071	100	2	30,892	100	0	39	100	95	10,477	95
8 Sep	0	1,071	100	0	30,892	100	0	39	100	78	10,555	95
9 Sep	0	1,071	100	0	30,892	100	0	39	100	61	10,616	96
10 Sep	0	1,071	100	1	30,893	100	0	39	100	76	10,692	97

-continued-

Table 1.–Page 3 of 3.

	Chinook Salmon			Chum Salmon			Sockeye Salmon			Coho Salmon		
Date	Daily	Cum.	Percent Passage	Daily	Cum.	Percent Passage	Daily	Cum.	Percent Passage	Daily	Cum.	Percent Passage
11 Sep	0	1,071	100	1	30,894	100	0	39	100	38	10,730	97
12 Sep	0	1,071	100	0	30,894	100	0	39	100	33	10,763	97
13 Sep	0	1,071	100	0	30,894	100	0	39	100	26	10,789	98
14 Sep	0	1,071	100	0	30,894	100	0	39	100	71	10,860	98
15 Sep	0	1,071	100	0	30,894	100	0	39	100	33	10,893	98
16 Sep	0	1,071	100	0	30,894	100	0	39	100	46	10,939	99
17 Sep	0	1,071	100	2	30,896	100	0	39	100	47	10,986	99
18 Sep	0	1,071	100	0	30,896	100	0	39	100	32	11,018	100
19 Sep [c]	0 [d]	1,071	100	0 [d]	30,896	100	0 [d]	39	100	25	11,043	100
20 Sep [c]	0 [d]	1,071	100	0 [d]	30,896	100	0 [d]	39	100	22	11,065	100

[a] Weir was not operational; daily passage was estimated from linear interpolation.

[b] A hole was discovered in the weir; daily passage was estimated using the "single-day method" as defined in the methods.

[c] The weir was removed early. Coho salmon passage estimated using the "exponential method" as described in the methods.

[d] The weir was removed early., Passage was assumed to be zero.

Table 2.–Age and sex composition of Chinook salmon at the Tatlawiksuk River weir in 2008 based on escapement samples collected with a live trap.

			Age Class																	
Sample Dates	Sample		1.1		1.2		1.3		2.2		1.4		2.3		1.5		2.4		Total	
(Stratum Dates)	Size	Sex	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%
7/8–14	56	M	0	0.0	57	10.7	221	41.1	0	0.0	58	10.7	0	0.0	0	0.0	0	0.0	336	62.5
(6/15–7/17)		F	0	0.0	10	1.8	105	19.6	0	0.0	86	16.1	0	0.0	0	0.0	0	0.0	201	37.5
		Subtotal[a]	0	0.0	67	12.5	326	60.7	0	0.0	144	26.8	0	0.0	0	0.0	0	0.0	537	100.0
7/18–25	37	M	0	0.0	43	8.1	202	37.9	0	0.0	72	13.5	0	0.0	0	0.0	0	0.0	318	59.5
(7/18–9/20)		F	0	0.0	0	0.0	87	16.2	0	0.0	130	24.3	0	0.0	0	0.0	0	0.0	216	40.5
		Subtotal[a]	0	0.0	43	8.1	289	54.1	0	0.0	202	37.8	0	0.0	0	0.0	0	0.0	534	100.0
Season[b]	93	M	0	0.0	101	9.4	423	39.5	0	0.0	130	12.1	0	0.0	0	0.0	0	0.0	653	61.0
		F	0	0.0	9	0.9	192	17.9	0	0.0	216	20.2	0	0.0	0	0.0	0	0.0	418	39.0
		Total	0	0.0	110	10.3	615	57.4	0	0.0	346	32.3	0	0.0	0	0.0	0	0.0	1,071	100.0
		95% C.I.				(±6.0)		(±9.9)				(±9.4)								

Note: Sample sizes for each age-sex class are provided in Table 3.

[a] The number of fish in each stratum age and sex category are derived from the sample percentages; discrepancies in sums are attributed to rounding errors.

[b] The number of fish in "Season" summaries are the strata sums; "Season" percentages are derived from the sums of the estimated escapement that occurred in each stratum.

Table 3.–Mean length (mm) of Chinook salmon at the Tatlawiksuk River weir in 2008 based on escapement samples collected with a live trap.

Sample Dates (Stratum Dates)	Sex		Age Class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4
7/8–14 (6/15–7/17)	M	Mean Length		569	689		761			
		SE		23	10		40			
		Range		493- 658	605- 769		657- 932			
		Sample Size	0	6	23	0	6	0	0	0
	F	Mean Length		620	698		796			
		SE		-	11		24			
		Range		620- 620	637- 750		697- 894			
		Sample Size	0	1	11	0	9	0	0	0
7/18–25 (7/18–9/20)	M	Mean Length		564	691		727			
		SE		57	15		23			
		Range		506- 678	626- 784		686- 813			
		Sample Size	0	3	14	0	5	0	0	0
	F	Mean Length			748		795			
		SE			27		23			
		Range			666- 824		719- 944			
		Sample Size	0	0	6	0	9	0	0	0
Season[a]	M	Mean Length		567	690		742			
		SE[b]			9		21			
		Range		493- 678	605- 784		657- 932			
		Sample Size	0	9	37	0	11	0	0	0
	F	Mean Length		620	720		795			
		SE[b]			13		16			
		Range		620- 620	637- 824		697- 944			
		Sample Size	0	1	17	0	18	0	0	0

Note: The sum of the sample sizes in each stratum equal the total sample size reported for that stratum in Table 2.

[a] "Season" mean lengths are weighted by abundance in each stratum.

[b] Standard error was not calculated for small samples.

Table 4.–Age and sex composition of chum salmon at the Tatlawiksuk River weir in 2008 based on escapement samples collected with a live trap.

			Age Class									
Sample Dates	Sample		0.2		0.3		0.4		0.5		Total	
(Stratum Dates)	Size	Sex	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%
7/8–12	204	M	0	0.0	200	2.4	4,084	50.0	80	1.0	4,365	53.4
(6/15–7/12)		F	0	0.0	521	6.4	3,284	40.2	0	0.0	3,804	46.6
		Subtotal[a]	0	0.0	721	8.8	7,368	90.2	80	1.0	8,169	100.0
7/13–17	188	M	0	0.0	908	8.5	3,804	35.7	341	3.2	5,054	47.3
(7/13–19)		F	0	0.0	1,306	12.2	4,316	40.4	0	0.0	5,621	52.7
		Subtotal[a]	0	0.0	2,214	20.7	8,120	76.1	341	3.2	10,675	100.0
7/20–23	211	M	0	0.0	567	9.0	2,237	35.5	60	0.9	2,863	45.5
(7/20–25)		F	0	0.0	1,103	17.5	2,326	37.0	0	0.0	3,430	54.5
		Subtotal[a]	0	0.0	1,670	26.5	4,563	72.5	60	0.9	6,293	100.0
7/27–8/22	196	M	0	0.0	705	12.3	1,646	28.6	118	2.1	2,468	42.9
(7/26–9/20)		F	147	2.6	1,264	21.9	1,851	32.1	29	0.5	3,291	57.1
		Subtotal[a]	147	2.6	1,969	34.2	3,497	60.7	147	2.6	5,759	100.0
Season[b]	799	M	0	0.0	2,381	7.7	11,771	38.1	598	1.9	14,750	47.7
		F	147	0.5	4,193	13.6	11,777	38.1	29	0.1	16,146	52.3
		Total	147	0.5	6,574	21.3	23,548	76.2	627	2.0	30,896	100.0
		95% C.I.		(±0.4)		(±2.8)		(±2.9)		(±1.0)		

Note: Sample sizes for each age-sex class are provided in Table 5.

[a] The number of fish in each stratum, age, and sex category are derived from the sample percentages; discrepancies in sums are attributed to rounding errors.

[b] The number of fish in "Season" summaries are strata sums; "Season" percentages are derived from the sums of the estimated escapement that occurred in each stratum.

Table 5.–Mean length (mm) of chum salmon at the Tatlawiksuk River weir in 2008 based on escapement samples collected with a live trap.

Sample Dates (Stratum Dates)	Sex		Age Class 0.2	0.3	0.4	0.5
7/8–12	M	Mean Length		585	590	610
(6/15–7/12)		SE		7	3	13
		Range		574-608	532-648	597-622
		Sample Size	0	5	102	2
	F	Mean Length		558	563	
		SE		7	3	
		Range		515-598	350-637	
		Sample Size	0	13	82	0
7/13–17	M	Mean Length		561	583	589
(7/13–19)		SE		7	3	7
		Range		510-635	523-648	568-610
		Sample Size	0	16	67	6
	F	Mean Length		520	543	
		SE		8	4	
		Range		445-607	409-608	
		Sample Size	0	23	76	0
7/20–23	M	Mean Length		556	570	590
(7/20–25)		SE		8	4	
		Range		494-620	507-654	590
		Sample Size	0	19	75	2
	F	Mean Length		531	539	
		SE		5	3	
		Range		459-589	470-607	
		Sample Size	0	37	78	0
7/27–8/22	M	Mean Length		561	560	537
(7/26–9/20)		SE		7	4	10
		Range		500-655	501-659	521-565
		Sample Size	0	24	56	4
	F	Mean Length	509	538	541	578
		SE	15	3	4	
		Range	473-550	500-575	454-610	578
		Sample Size	5	43	63	1
Season[a]	M	Mean Length		562	580	582
		SE[b]		4	2	8
		Range		494-655	501-659	521-622
		Sample Size	0	64	300	14
	F	Mean Length	509	533	548	578
		SE[b]		3	2	
		Range	473-550	445-607	350-637	578
		Sample Size	5	116	299	1

Note: The sum of the sample sizes in each stratum equal the total sample size reported for that stratum in Table 4.

[a] "Season" mean lengths are weighted by abundance in each stratum.

[b] Standard error was not calculated for small samples.

Table 6.–Age and sex composition of coho salmon at the Tatlawiksuk River weir in 2008 based on escapement samples collected with a live trap.

			Age Class							
Sample Dates	Sample		1.1		2.1		3.1		Total	
(Stratum Dates)	Size	Sex	Esc.	%	Esc.	%	Esc.	%	Esc.	%
8/10–14	83	M	46	1.2	1,700	44.6	92	2.4	1,838	48.2
(6/15–8/16)		F	46	1.2	1,884	49.4	46	1.2	1,976	51.8
		Subtotal[a]	92	2.4	3,584	94.0	138	3.6	3,814	100.0
8/19–27	237	M	169	2.9	2,202	38.4	435	7.6	2,807	48.9
(8/17–30)		F	97	1.7	2,493	43.5	339	5.9	2,929	51.1
		Subtotal[a]	266	4.6	4,695	81.9	774	13.5	5,736	100.0
9/3–14	165	M	18	1.2	459	30.3	110	7.3	588	38.8
(8/31–9/20)		F	46	3.0	588	38.8	294	19.4	927	61.2
		Subtotal[a]	64	4.2	1,047	69.1	404	26.7	1,515	100.0
Season[b]	485	M	233	2.1	4,361	39.4	637	5.8	5,233	47.3
		F	189	1.7	4,965	44.9	679	6.1	5,832	52.7
		Total	422	3.8	9,326	84.3	1,316	11.9	11,065	100.0
		95% C.I.		(±1.8)		(±3.2)		(±2.8)		

Note: Sample sizes for each age-sex class are provided in Table 7.

[a] The number of fish in each stratum age and sex category are derived from the sample percentages; discrepancies in sums are attributed to rounding errors.

[b] The number of fish in "Season" summaries are strata sums; "Season" percentages are derived from the sums of the estimated escapement that occurred in each stratum.

Table 7.–Mean length (mm) of coho salmon at the Tatlawiksuk River weir in 2008 based on escapement samples collected with a live trap.

Sample Dates (Stratum Dates)	Sex		Age Class 1.1	2.1	3.1
8/10–14 (6/15–8/16)	M	Mean Length	524	544	543
		SE		7	37
		Range	524- 524	445- 618	506- 579
		Sample Size	1	37	2
	F	Mean Length	574	546	500
		SE		5	
		Range	574- 574	501- 640	500- 500
		Sample Size	1	41	1
8/19–27 (8/17–30)	M	Mean Length	529	534	545
		SE	12	4	7
		Range	481- 575	415- 600	479- 584
		Sample Size	7	91	18
	F	Mean Length	535	543	546
		SE	12	3	6
		Range	502- 560	426- 596	506- 598
		Sample Size	4	103	14
9/3–14 (8/31–9/16)	M	Mean Length	507	549	569
		SE	44	5	11
		Range	463- 551	458- 604	508- 610
		Sample Size	2	50	12
	F	Mean Length	549	541	554
		SE	10	3	5
		Range	523- 571	475- 603	485- 605
		Sample Size	5	64	32
Season[a]	M	Mean Length	526	539	548
		SE[b]		4	7
		Range	463- 575	415- 618	479- 610
		Sample Size	10	178	32
	F	Mean Length	548	544	546
		SE[b]		2	
		Range	502- 574	426- 640	485- 605
		Sample Size	10	208	47

Note: The sum of the sample sizes in each stratum equal the total sample size reported for that stratum in Table 6.

[a] "Total Sample" mean lengths are weighted by abundance in each stratum.

[b] Standard error was not calculated for small samples.

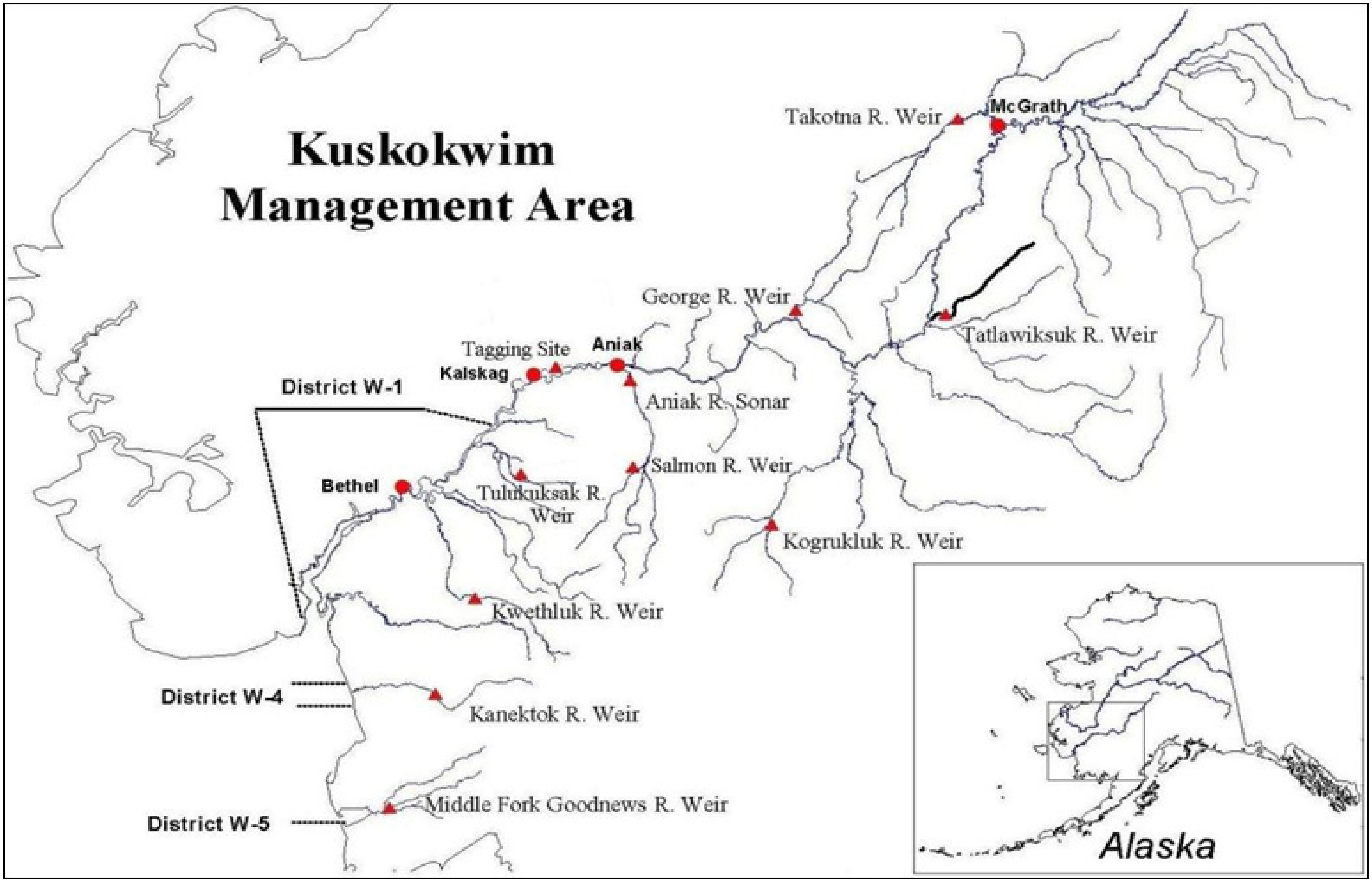


Figure 1.–Location of Kuskokwim Area salmon management districts and escapement monitoring projects with emphasis on the Tatlawiksuk River.

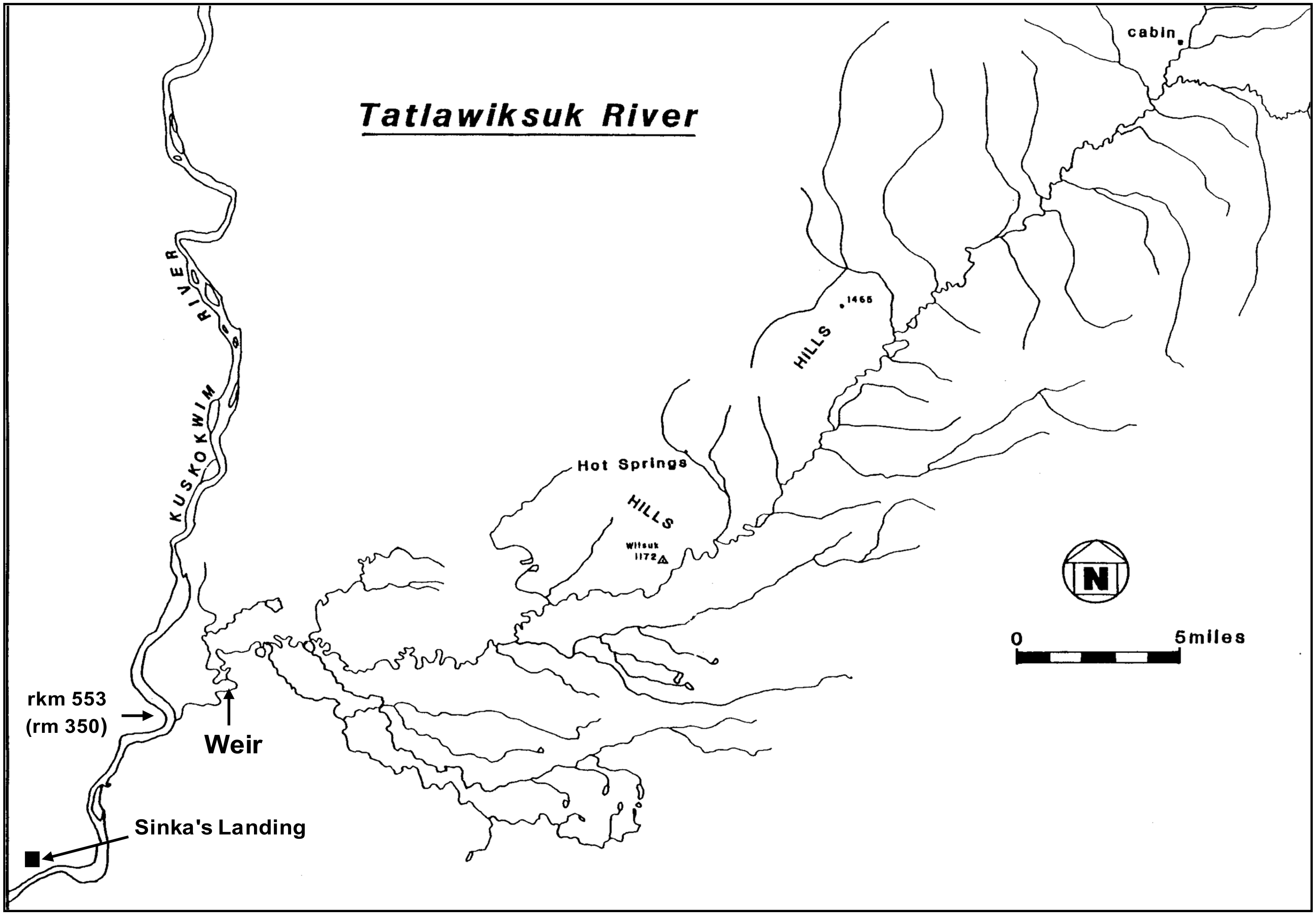
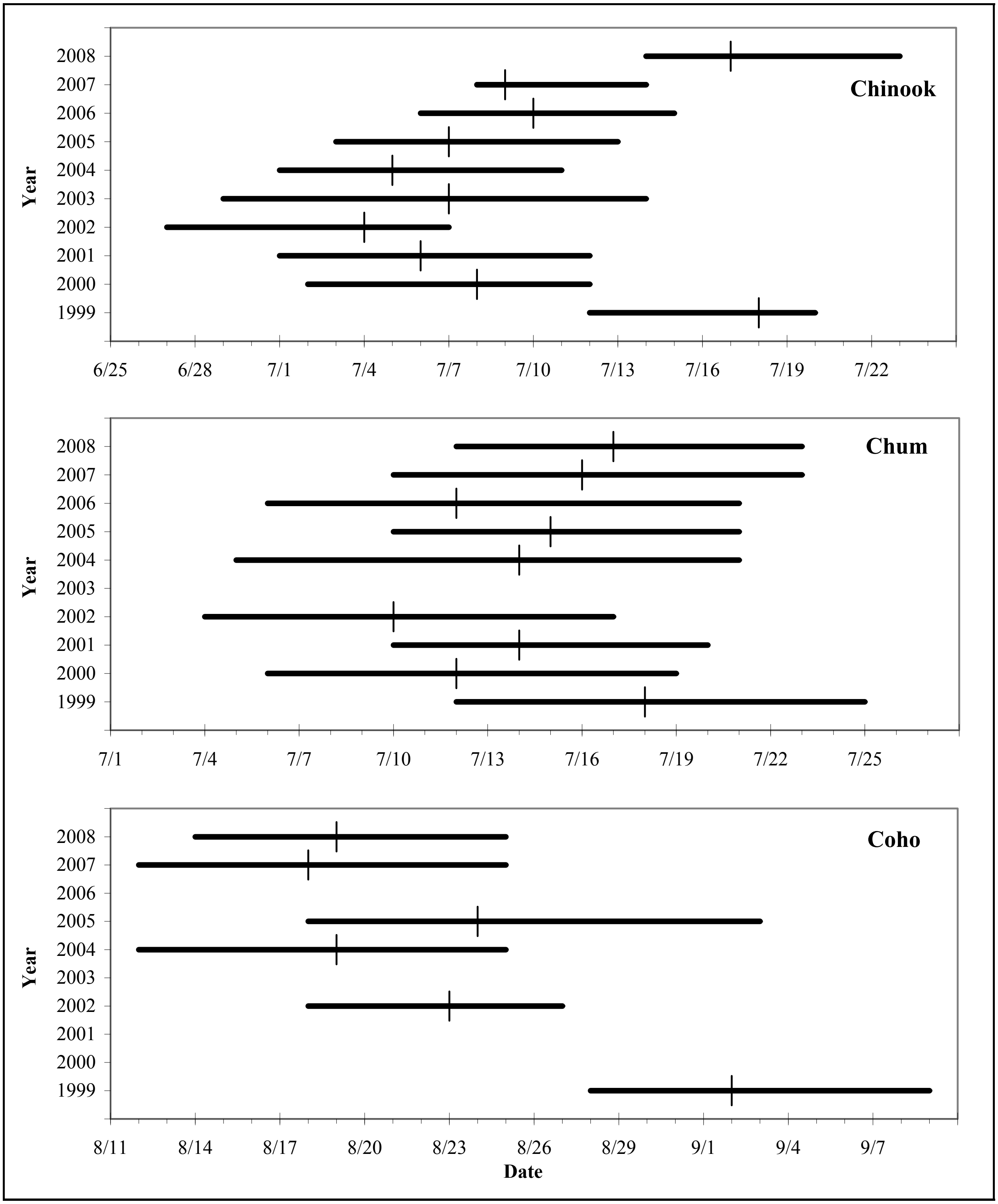


Figure 2.–Tatlawiksuk River drainage and the location of the weir.



Note: Solid lines represent the dates when the central 50% of the run passed and cross-bars represent the median passage date.

Figure 3.–Annual run timing of Chinook, chum, and coho salmon based on cumulative percent passage at the Tatlawiksuk River weir, 1999–2008.

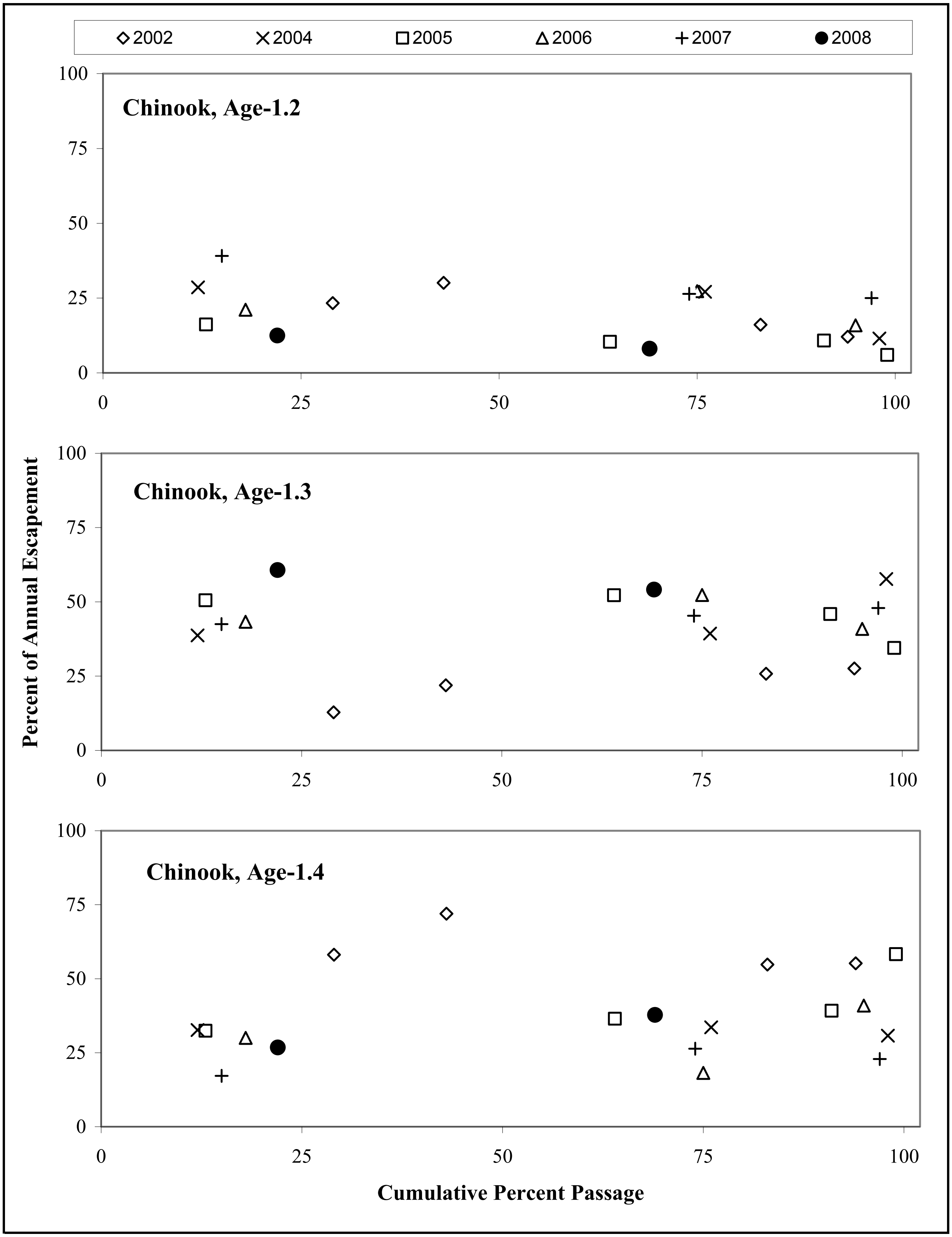


Figure 4.–Historical age composition of Chinook salmon by cumulative percent passage at Tatlawiksuk River weir.

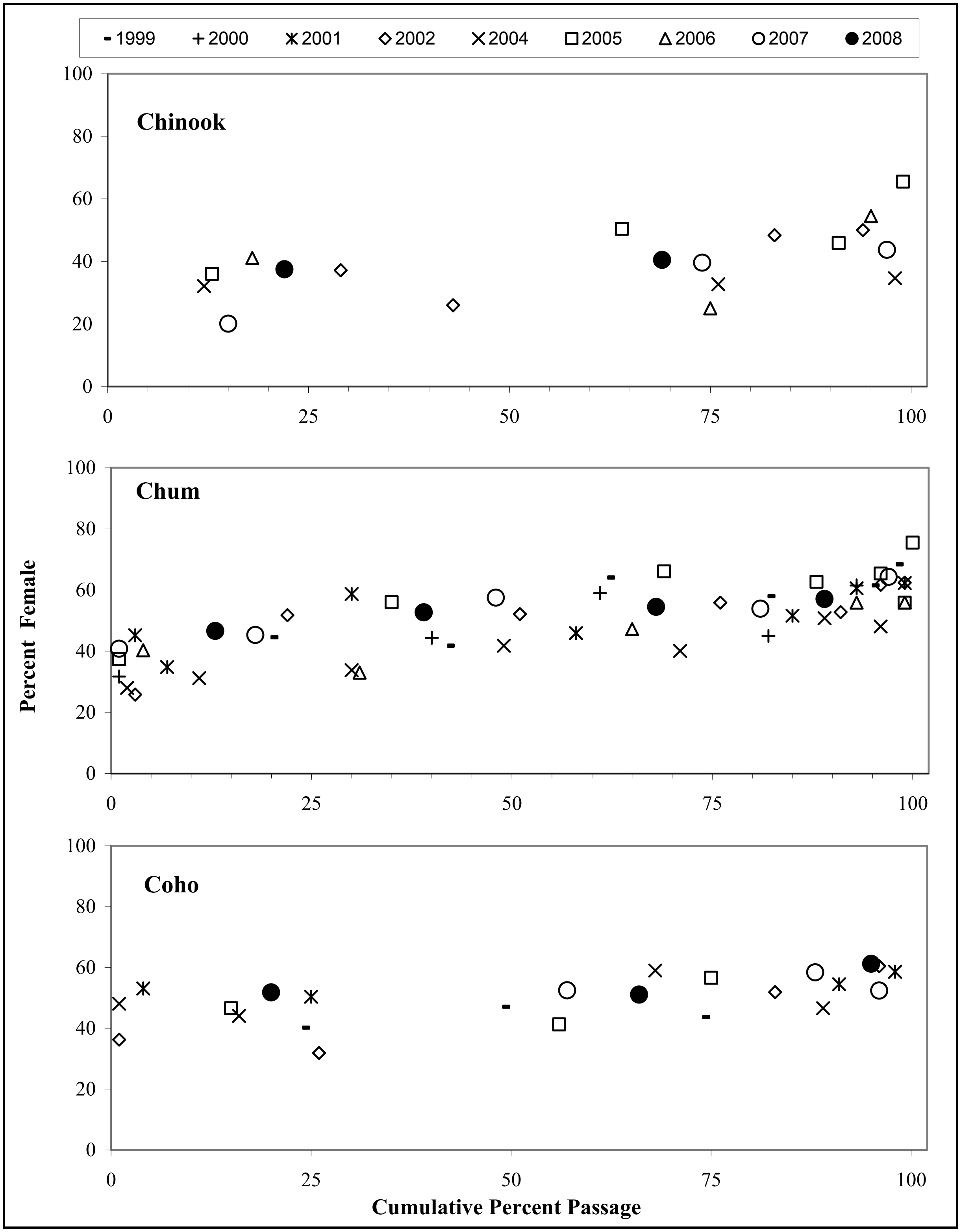


Figure 5.–Historical percentage of female Chinook, chum, and coho salmon by cumulative percent passage at the Tatlawiksuk River weir.

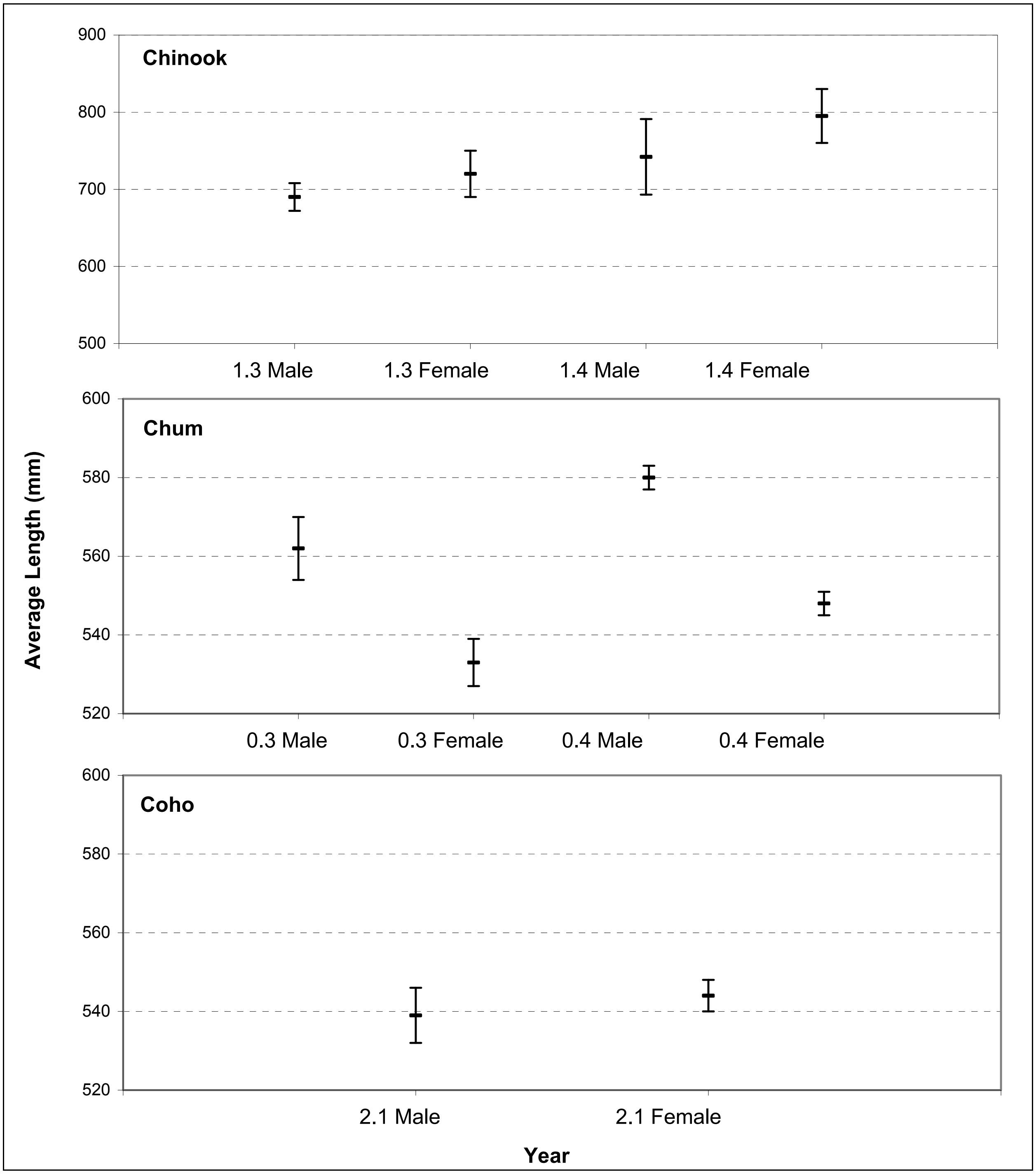


Figure 6.–Mean length-at-age of male and female Chinook, chum, and coho salmon at the Tatlawiksuk River weir in 2008, with 95% confidence intervals.

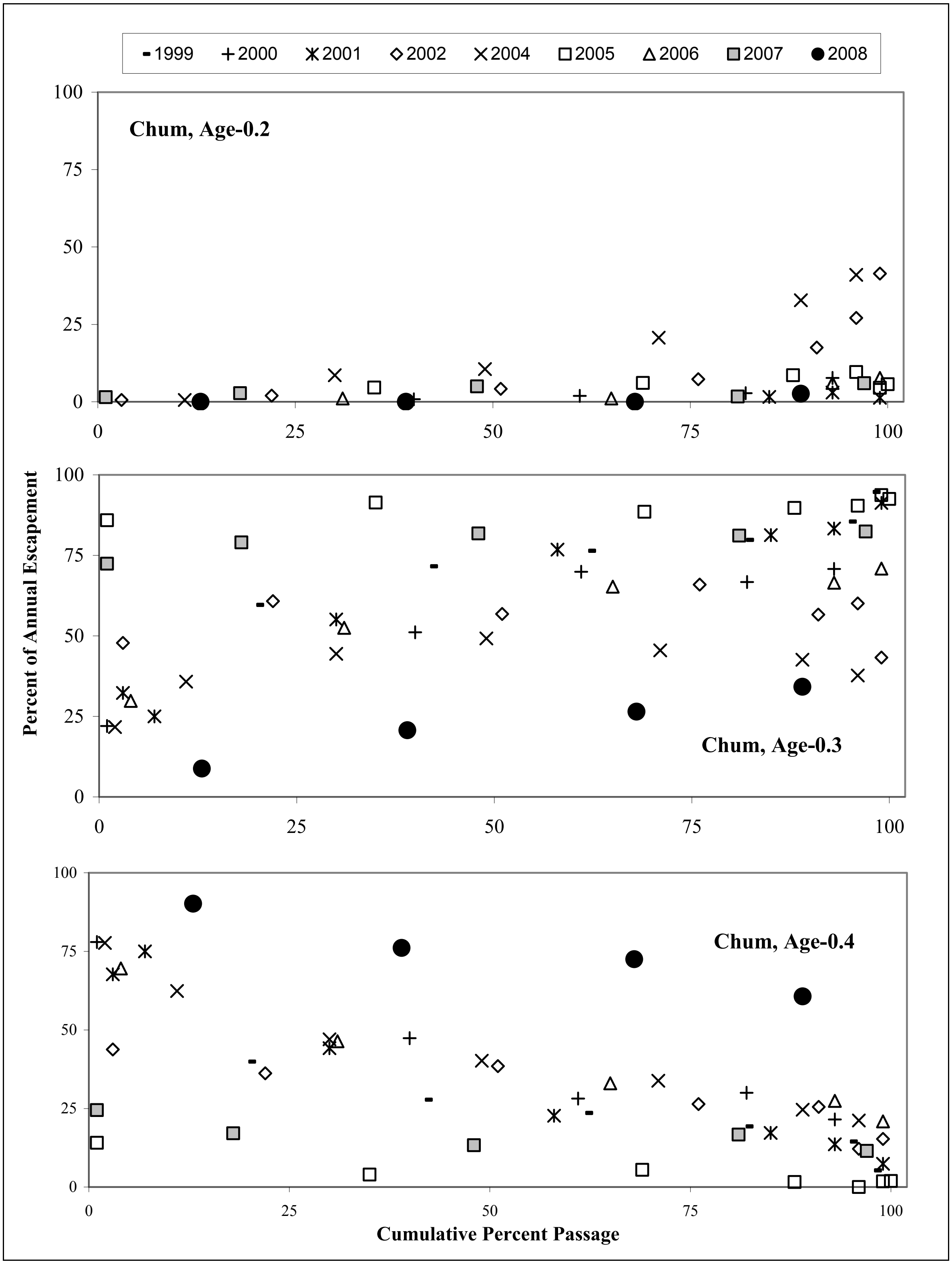


Figure 7.–Historical age composition of chum salmon by cumulative percent passage at Tatlawiksuk River weir.

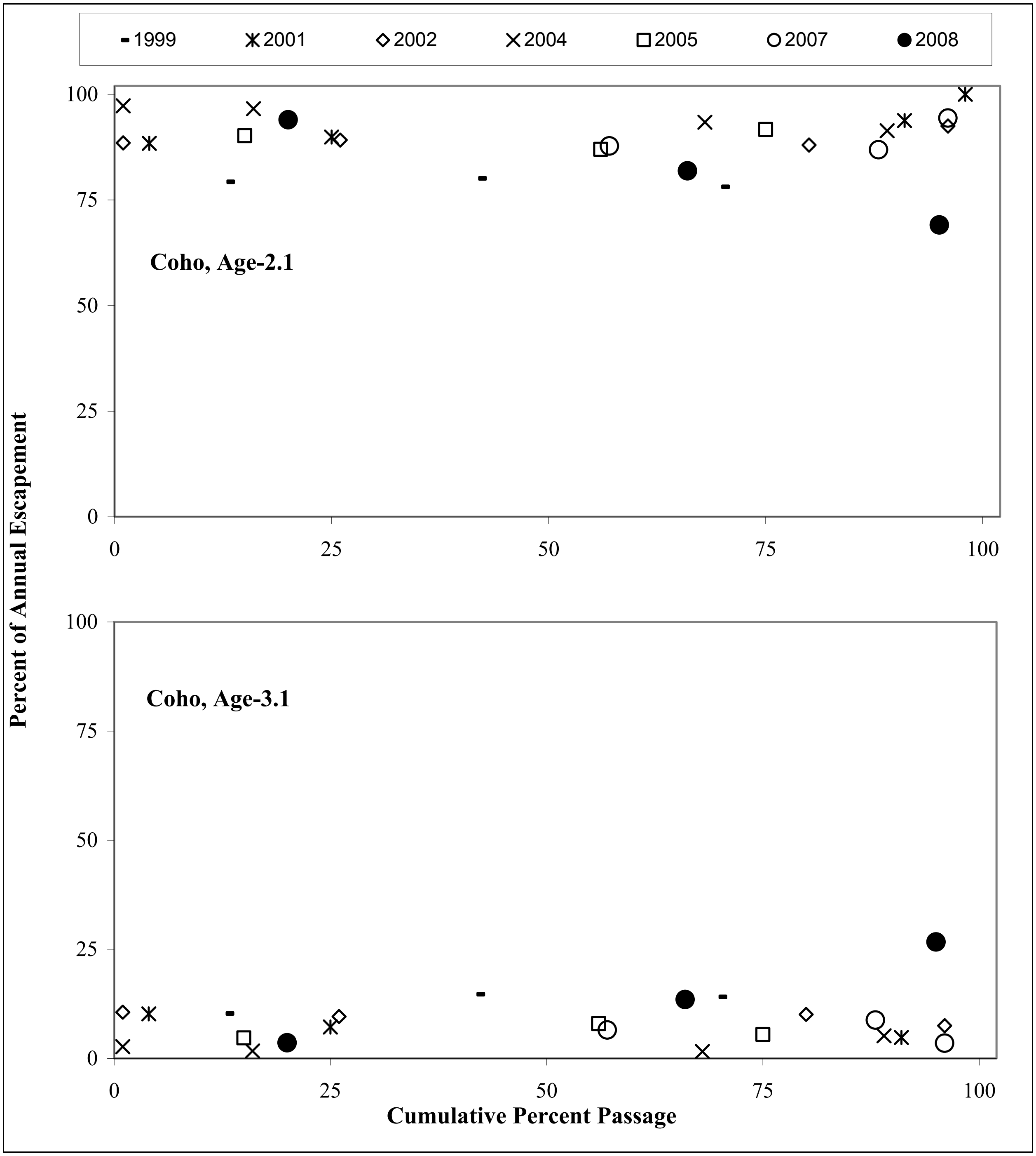


Figure 8.–Historical age composition of coho salmon by cumulative percent passage at Tatlawiksuk River weir.

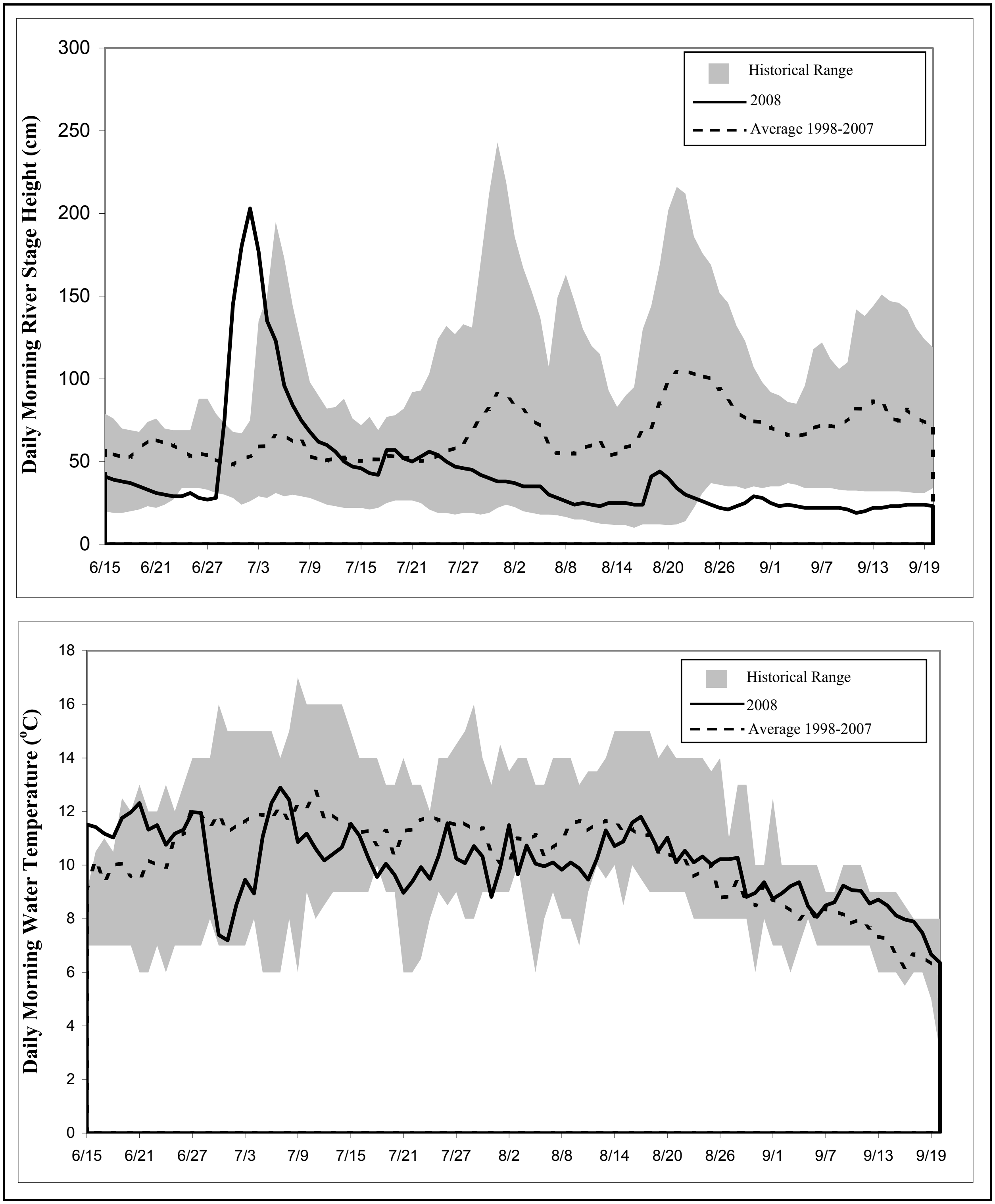


Figure 9.–Comparison of daily morning river stage and temperature measurements in 2008 with historical range and averages at Tatlawiksuk river weir.

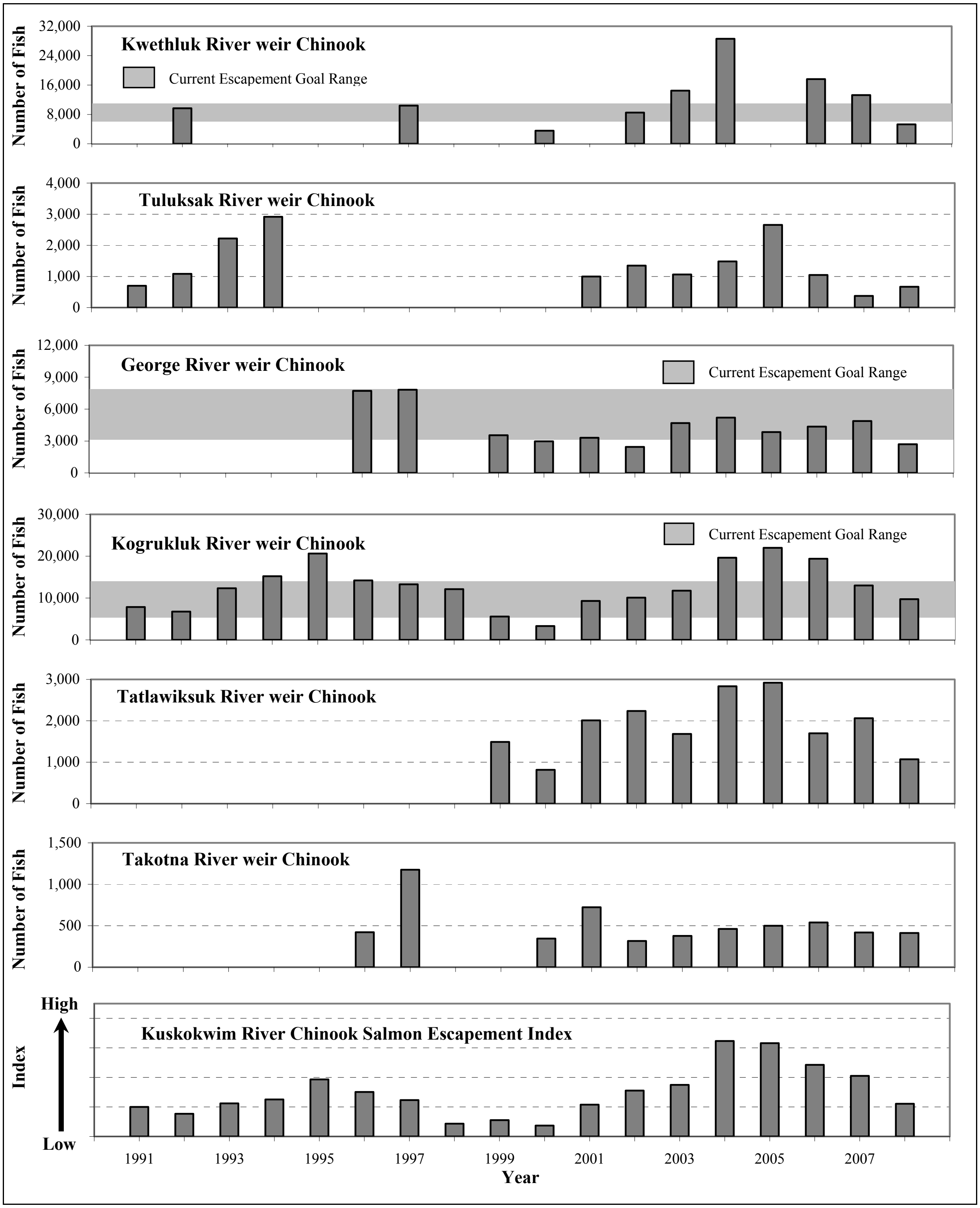


Figure 10.–Annual Chinook salmon escapement into 6 Kuskokwim River tributaries and the Kuskokwim River Chinook salmon escapement indices, 1991–2008.

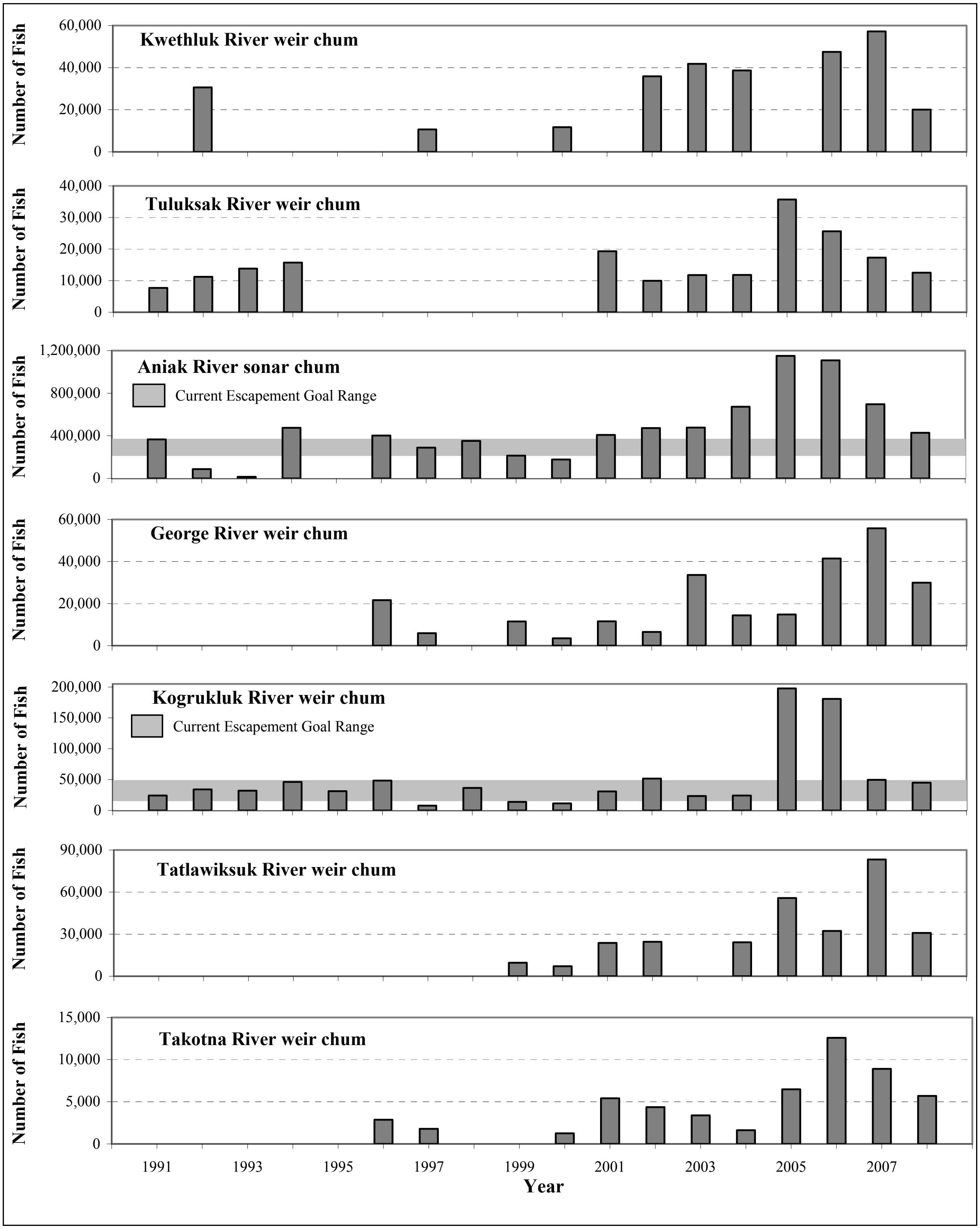


Figure 11.–Annual chum salmon escapement into 7 Kuskokwim River tributaries, 1991–2008.

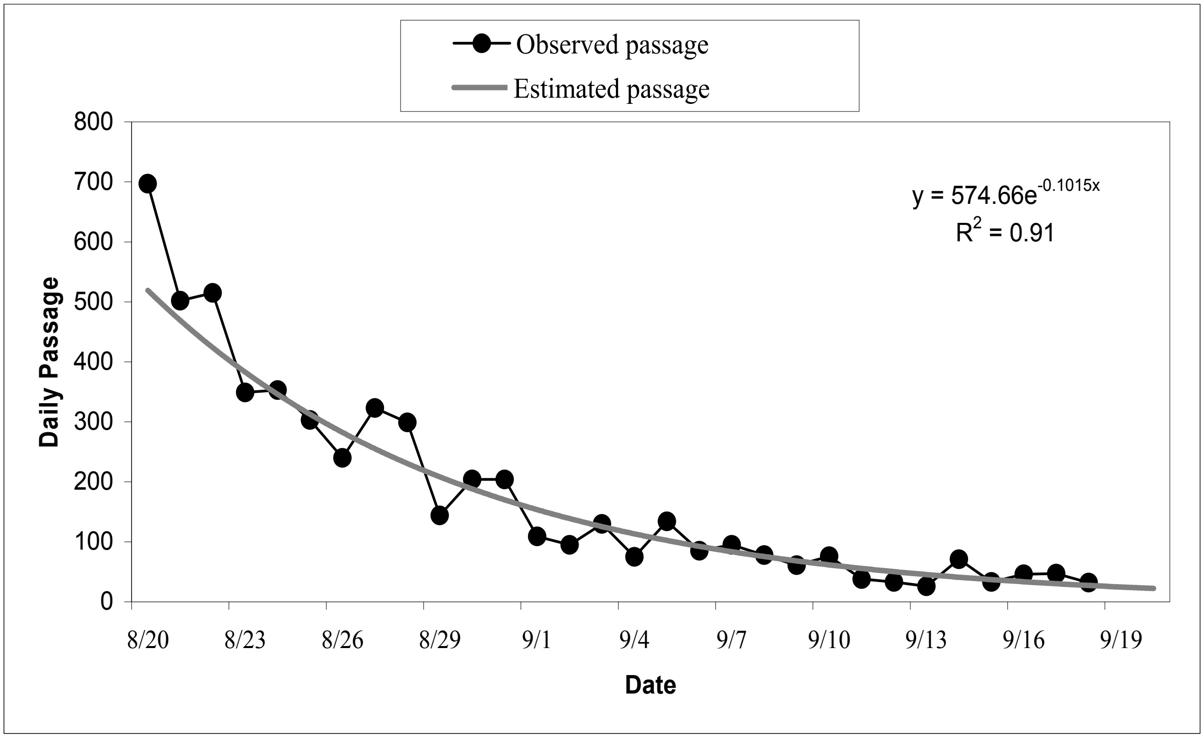


Figure 12.–Observed daily passage of coho salmon compared to a regression line used to estimate daily passage on 19 and 20 September at Tatlawiksuk River weir.

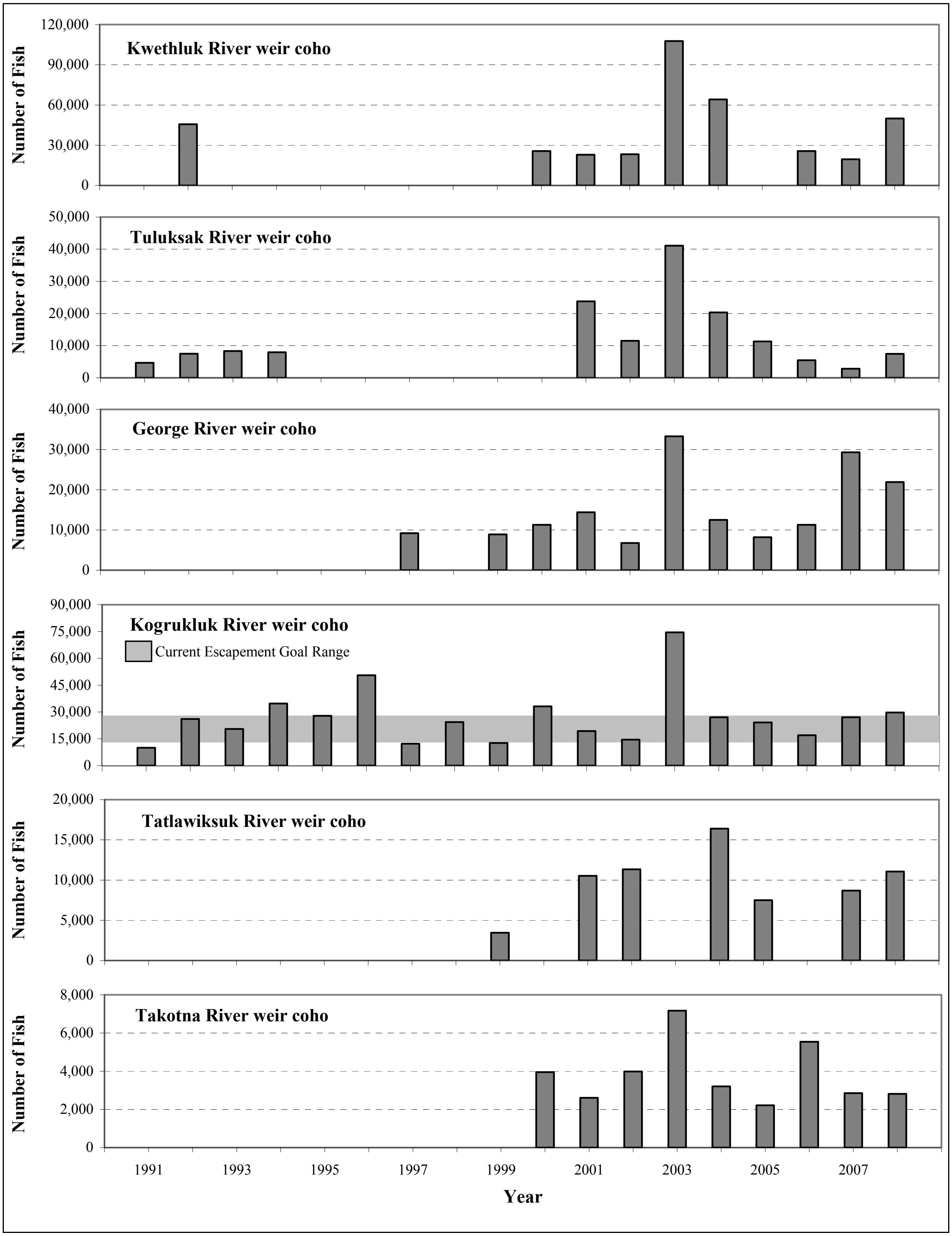


Figure 13.–Annual coho salmon escapement into 6 Kuskokwim River tributaries, 1991–2008.

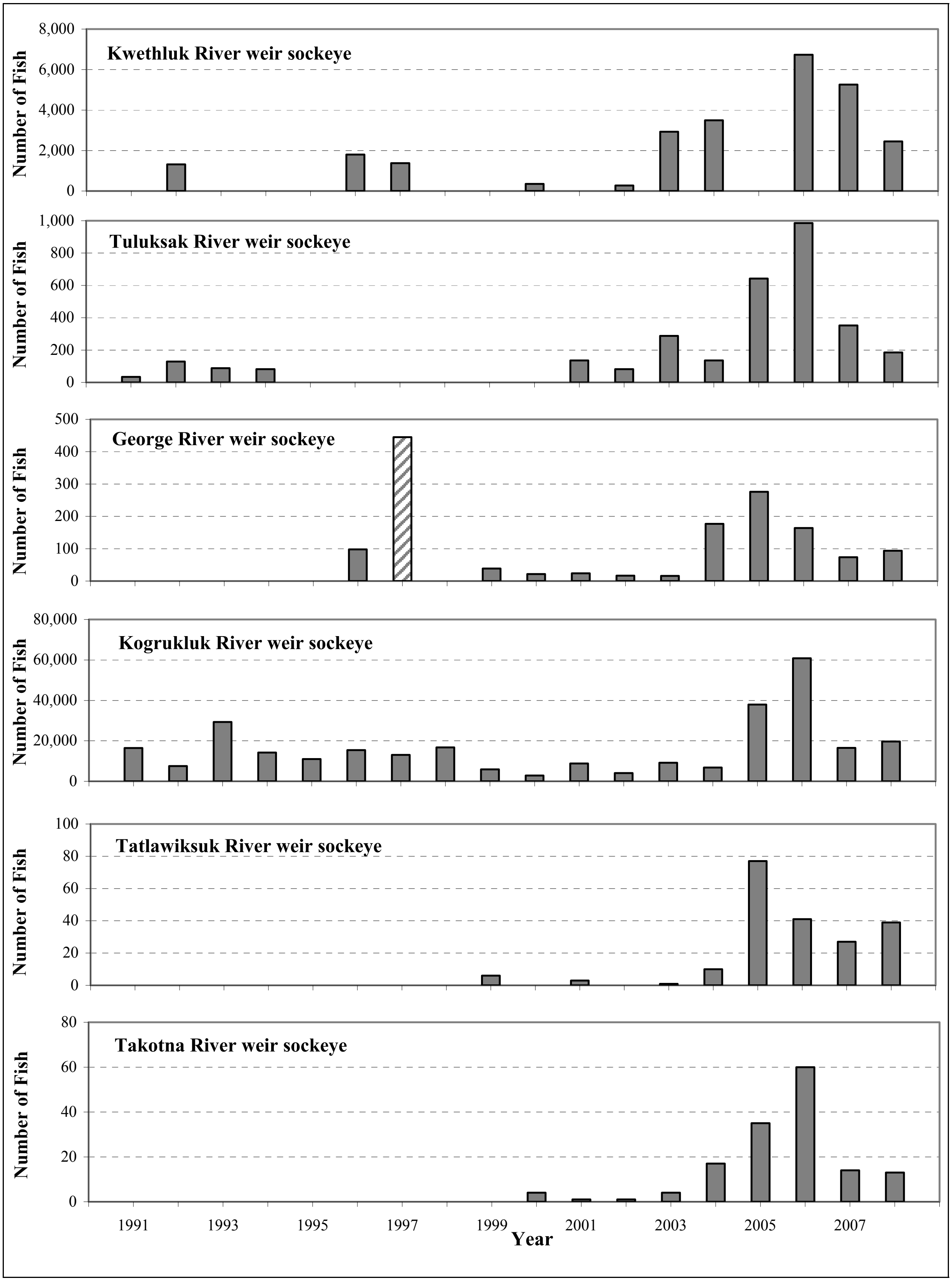
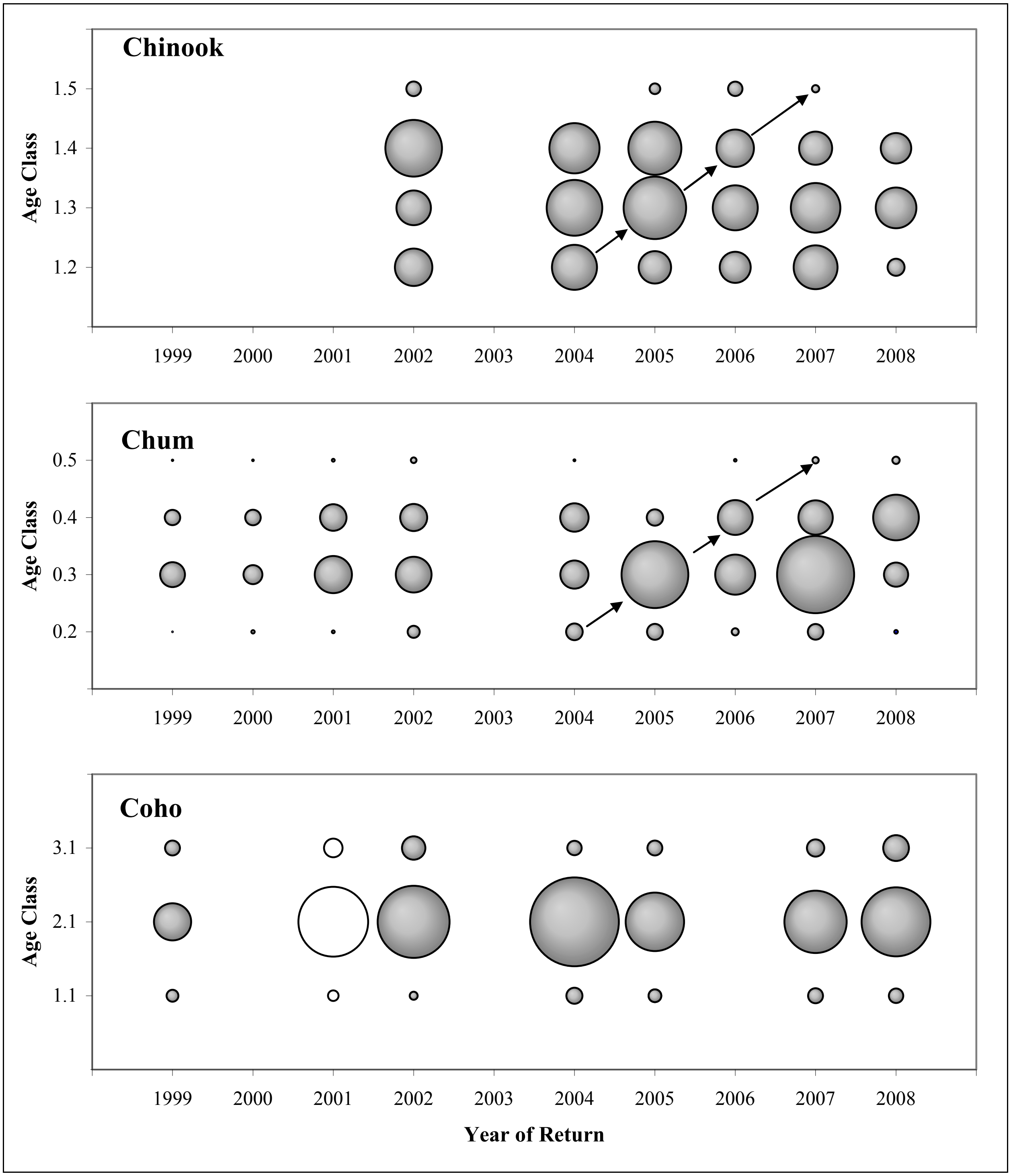


Figure 14.–Annual sockeye salmon escapement into 6 Kuskokwim River Tributaries, 1997–2008.



Note: Size of circles represents relative abundance and arrows illustrate tracking a cohort group. Plots that appear empty (white) correspond to years when greater than 20% of reported escapement was derived from daily passage estimates. Years when sample objectives were not achieved contain no data plots.

Figure 15.–Relative age-class abundance of Chinook, chum, and coho salmon by return year at Tatlawiksuk River weir, 1999–2008.

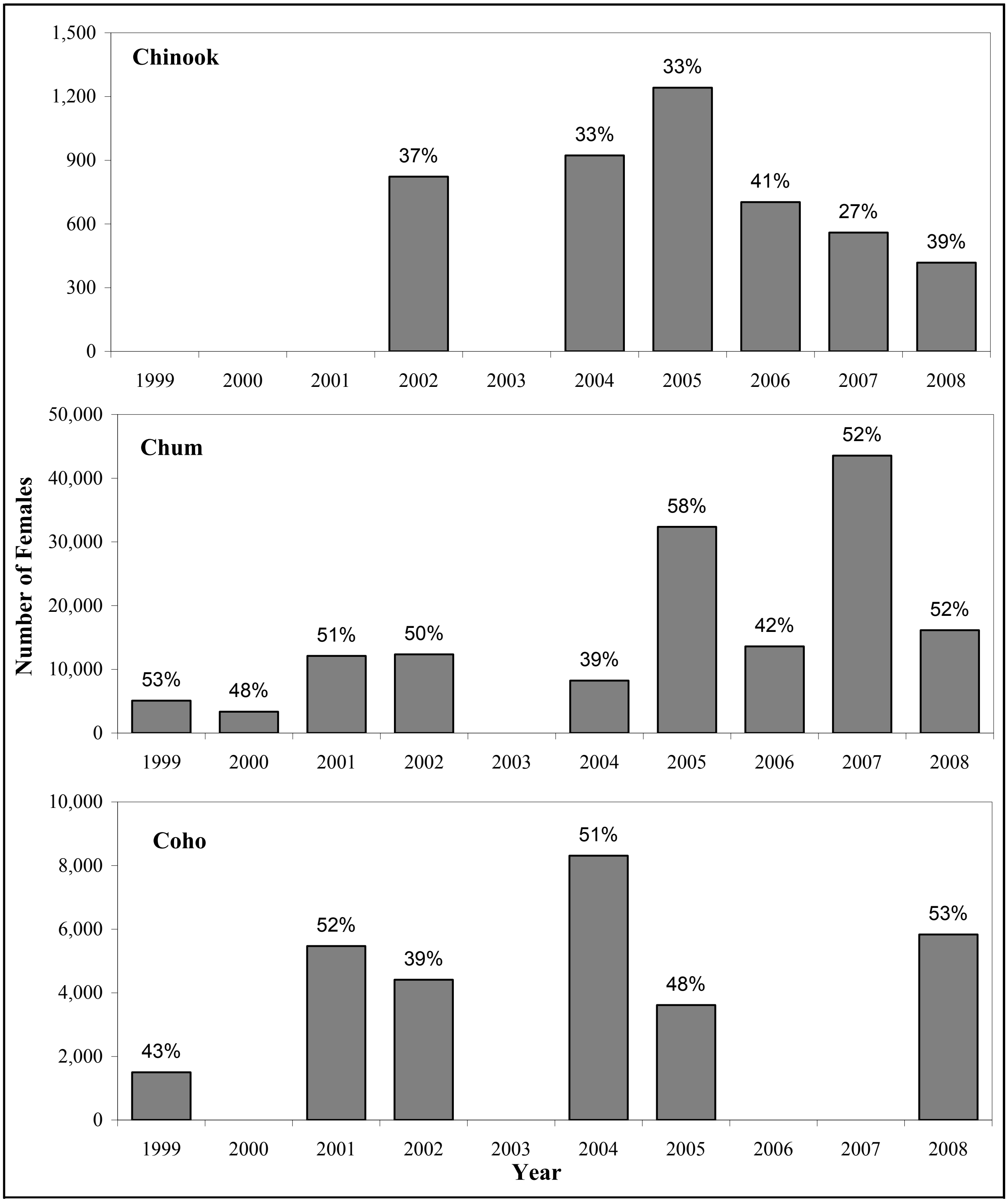


Figure 16.–Historical annual escapement of female salmon at Tatlawiksuk River weir, with labels indicating the percent of total escapement comprised of females.

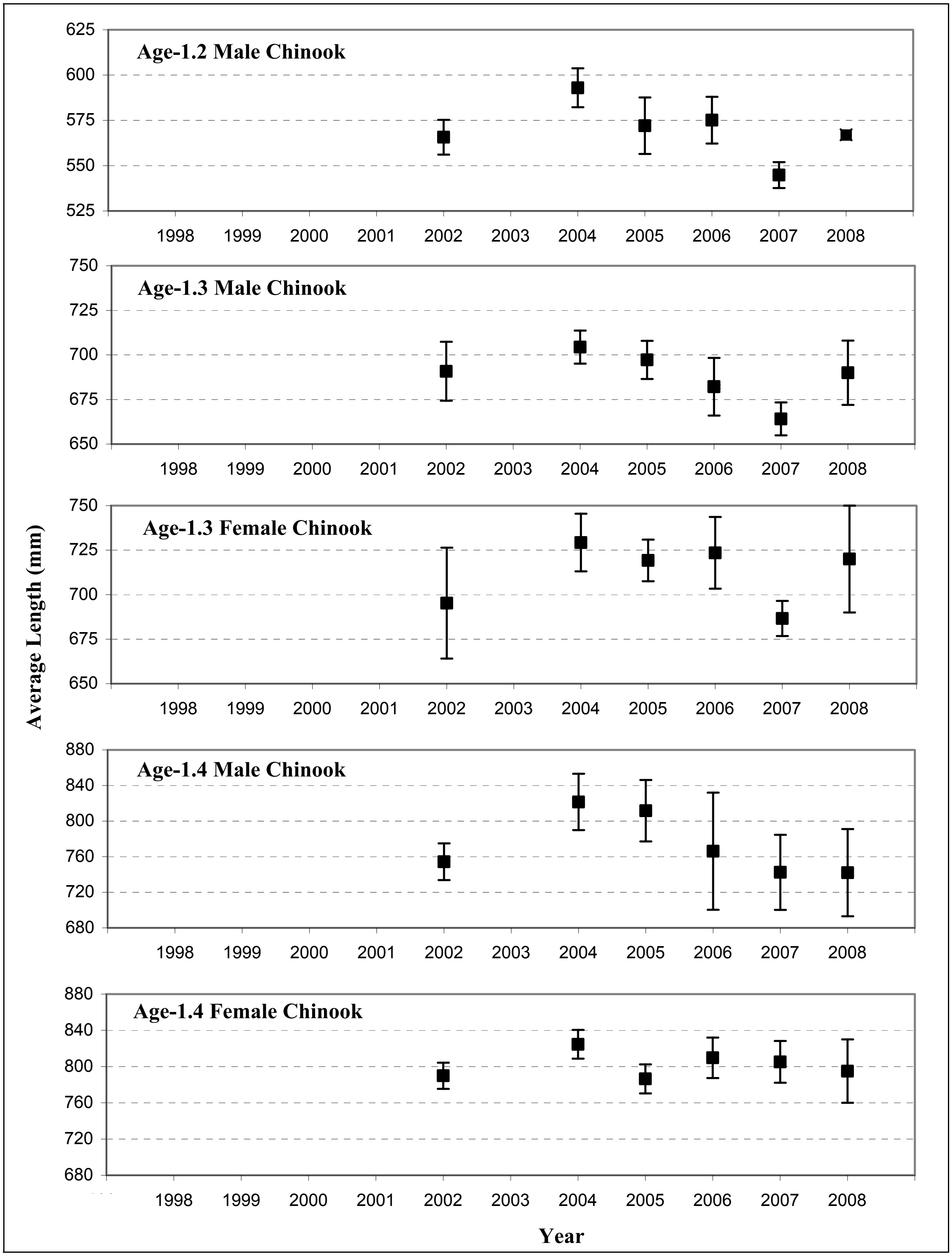


Figure 17.–Historical average annual length with 95% confidence intervals for Chinook salmon at the Tatlawiksuk River weir.

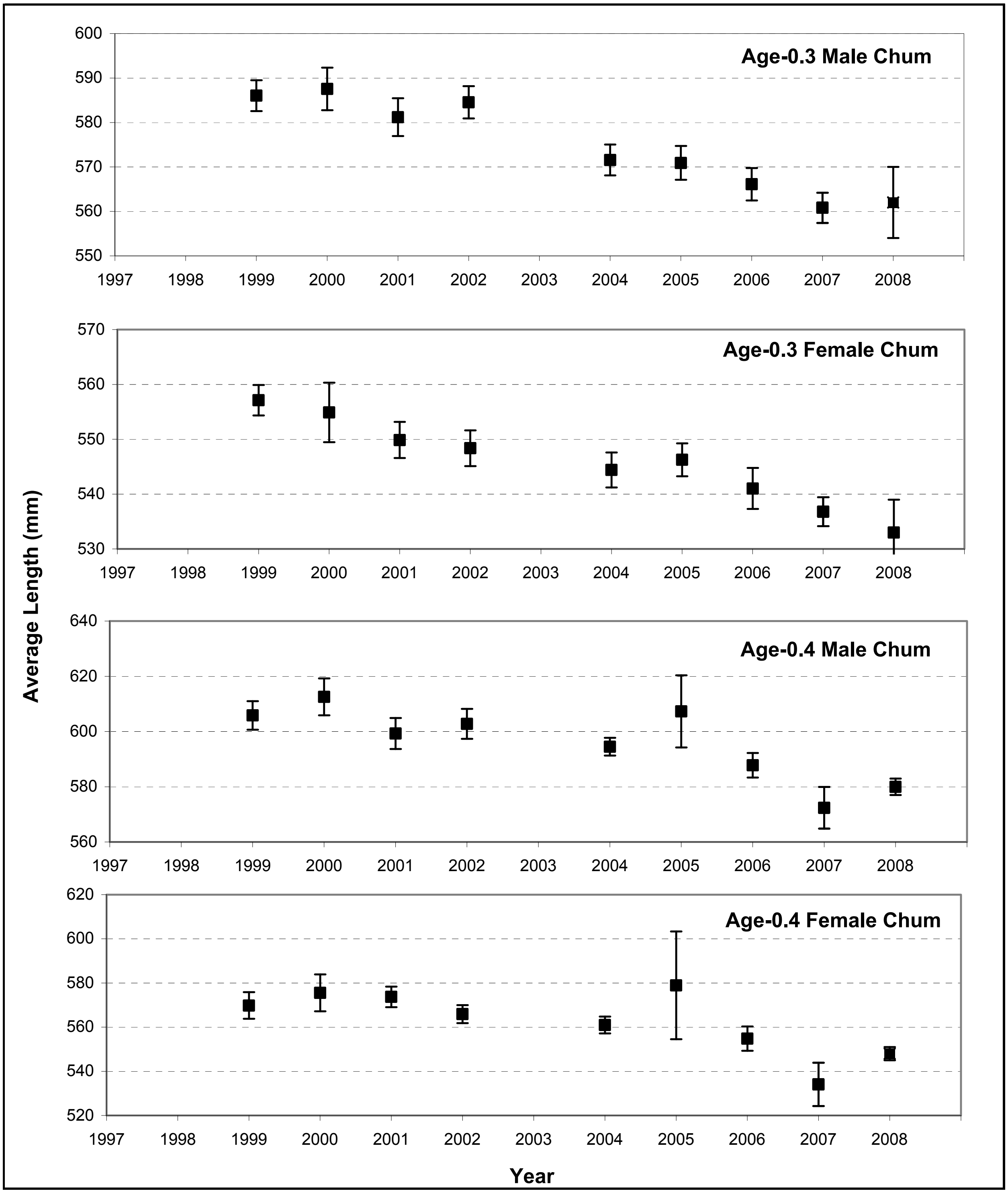


Figure 18.–Historical average annual length with 95% confidence intervals for chum salmon at the Tatlawiksuk River weir.

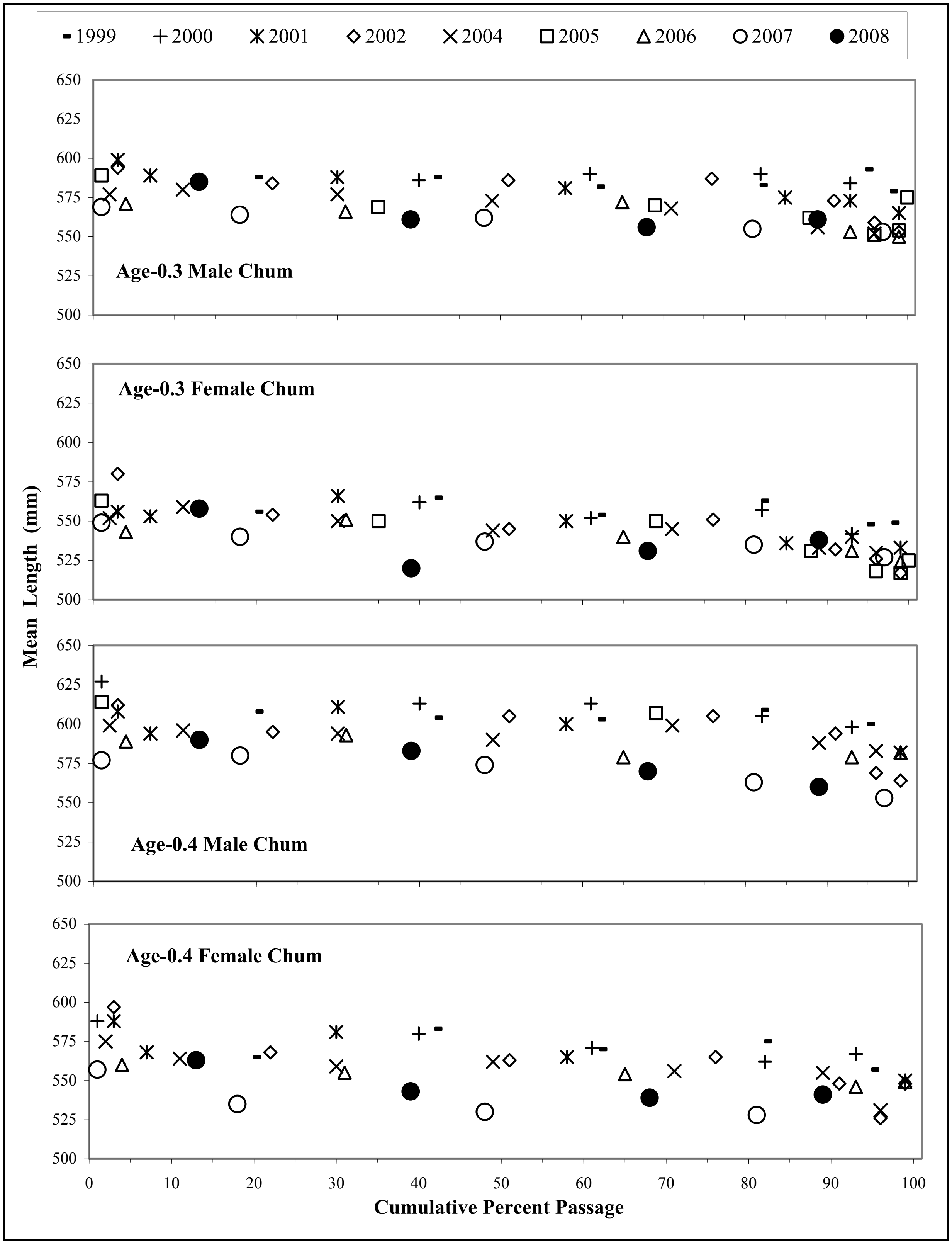


Figure 19.–Historical mean length-at-age of chum salmon by cumulative percent passage at the Tatlawiksuk River weir.

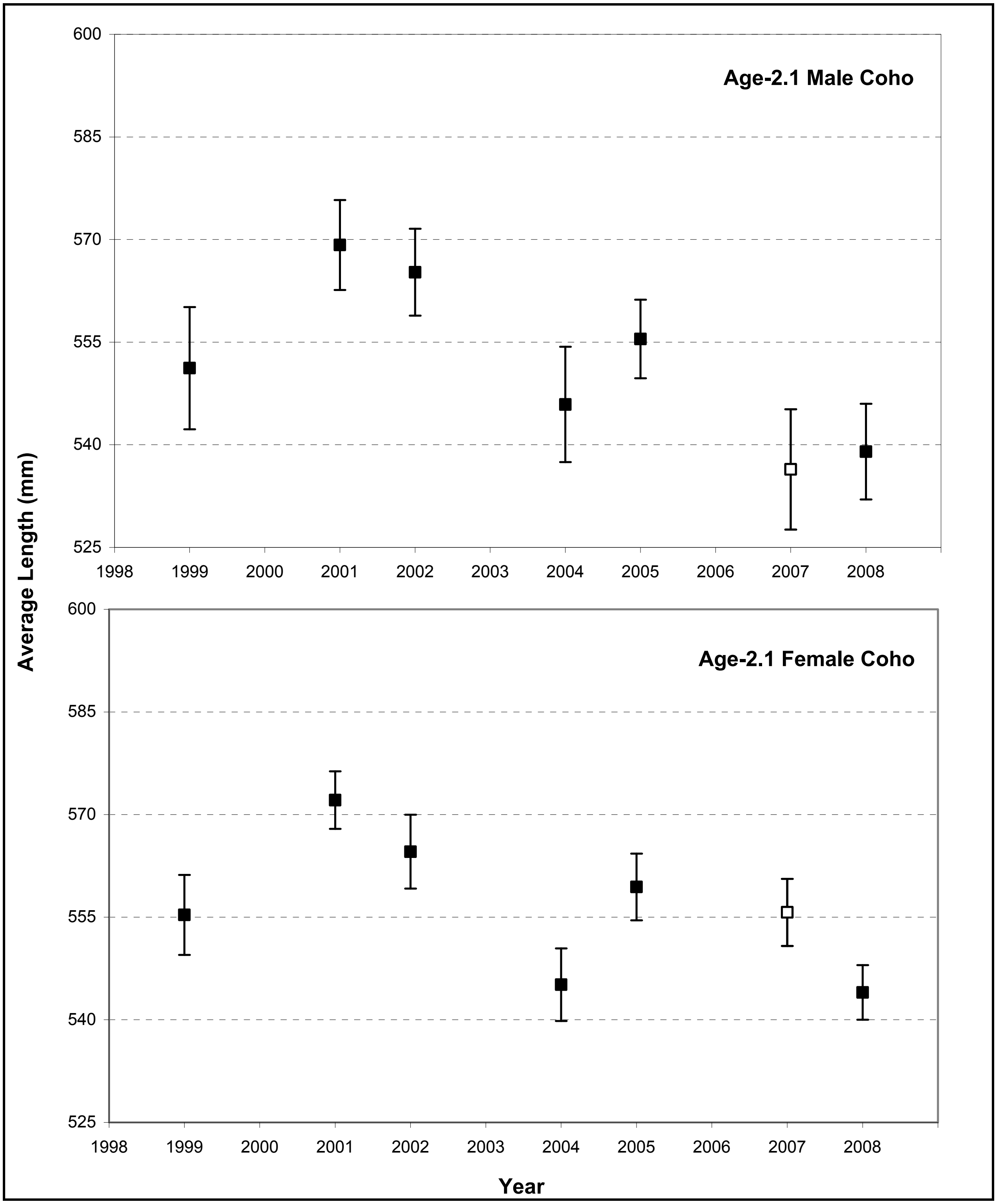


Figure 20.–Historical average annual length with 95% confidence intervals for coho salmon at the Tatlawiksuk River weir.

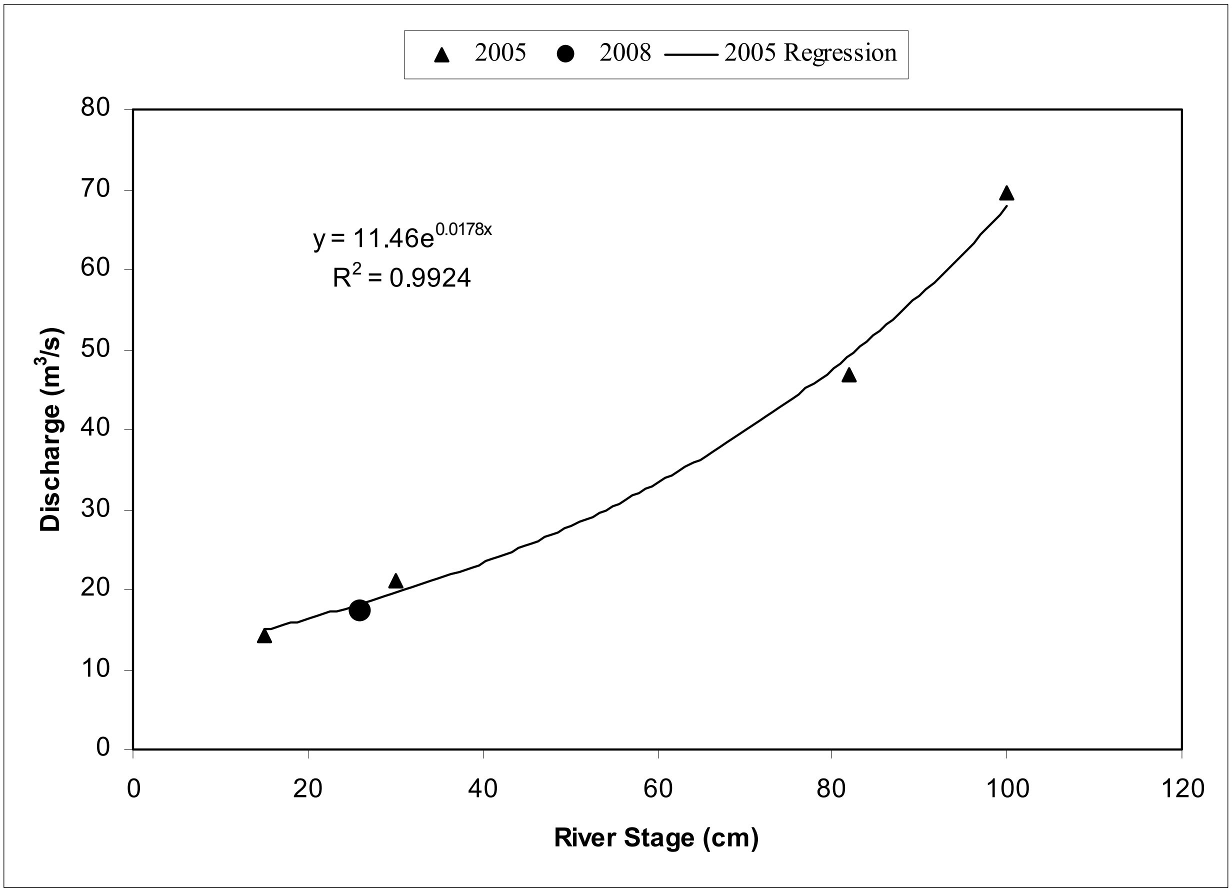


Figure 21.–Stage-discharge relationship from Costello et al. (2006) compared to the 2008 discharge measurement.

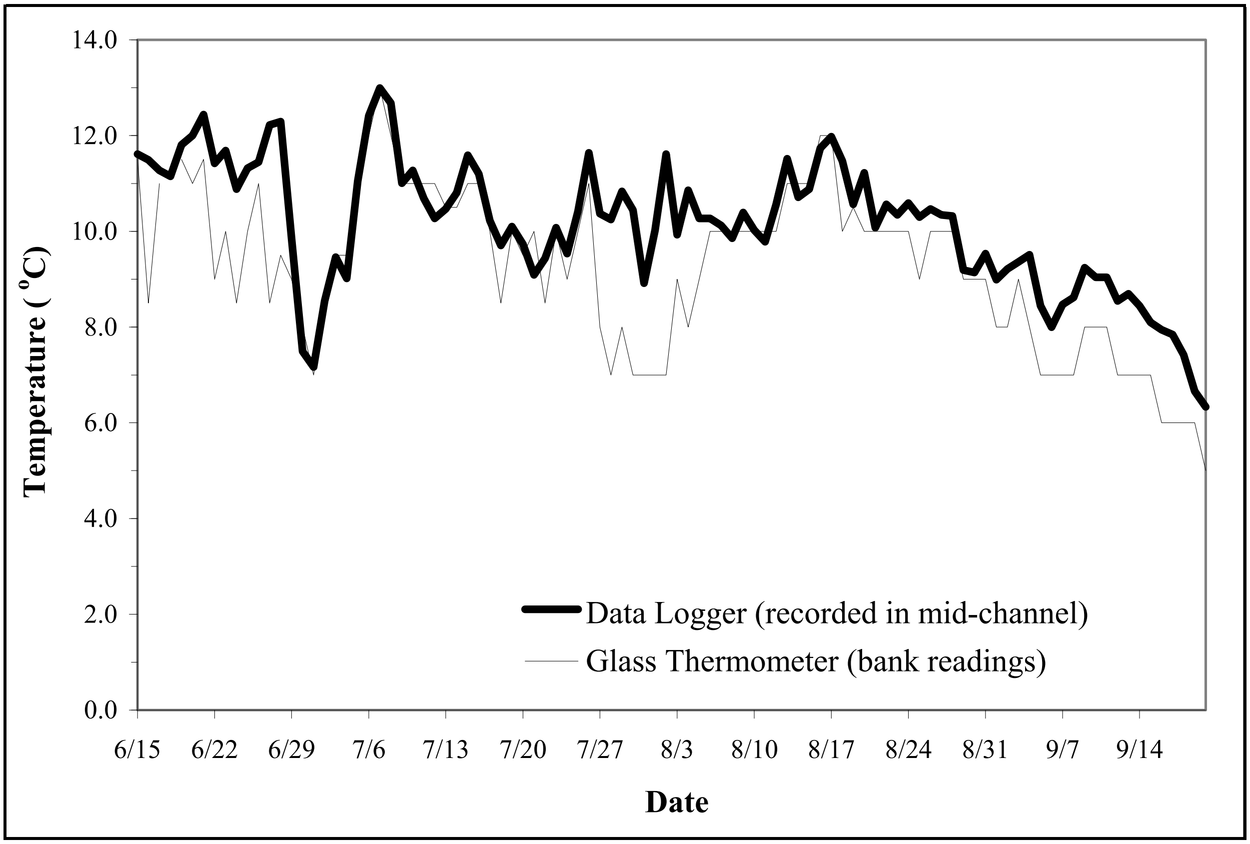


Figure 22.–Comparison of daily morning water temperature from a data logger installed near mid-channel with readings taken from a glass thermometer along the bank at Tatlawiksuk River weir in 2008.

APPENDIX A. WEATHER AND STREAM OBSERVATIONS

Appendix A1.–Photograph showing the benchmark (river level = 300 cm) established in 2005, and located in the panel storage area at Tatlawiksuk River weir.

Appendix A2.–Daily weather and stream observations at the Tatlawiksuk River weir site, 2008.

Date	Time	Sky Conditions[a]	Precipitation (mm)[b]	Temperature (°C) Air	Temperature (°C) Water	River Stage (cm)	Water Clarity[c]
6/10	10:00		0.0			48	2
6/11	10:00	4	2.8			46	2
6/12	10:00		0.0			45	2
6/13	10:00	4	1.0			44	2
6/14	10:00	1	0.0			42	2
6/15	10:00	3	0.3	14.0	11.5	41	2
	20:30	4	0.3	11.5		39	2
6/16	10:00	4	3.0	11.5	8.5	39	2
	20:30	3	0.0	14.5	11.0	39	2
6/17	10:30	3	0.0	15.5	11.0	38	1
6/18	07:15	1	0.0			37	1
	16:30	2	0.0	20.0	13.0	36	1
6/19	07:15	2	0.0	10.0	11.5	35	1
	20:30	1	0.0	22.0	14.0	33	1
6/20	07:15	2	0.0	11.0	11.0	33	1
	17:00	2	0.0	19.0	11.0	32	1
6/21	07:30	1	0.0	11.0	11.5	31	1
	17:00	4	0.6	15.0	12.0	31	1
6/22	07:30	1	0.0	7.0	9.0	30	1
	17:00	3	0.0	19.0	12.0	29	1
6/23	07:30	4	0.5	9.0	10.0	29	1
	17:00	3	8.0	14.0	11.0	29	1
6/24	07:30	3	0.0	9.0	8.5	29	1
	17:00	2	0.0	16.0		32	1
6/25	07:30	2	0.0	6.0	10.0	31	1
	17:00	3	0.0	15.0	13.0	31	1
6/26	07:30	2	0.0	7.0	11.0	28	1
	17:00	2	0.0	23.5	11.5	27	1
6/27	07:30	2	0.0	4.0	8.5	27	1
	17:00	2	0.0	19.0	14.0	26	1
6/28	10:00	4	31.0	8.5	9.5	28	1
	17:00	4	8.0	11.0	10.0	31	1
6/29	10:00	4	24.0	8.0	9.0	75	3
	17:00	4	11.0	11.0	9.0	106	3
6/30	07:30	4	11.0	8.5	8.0	145	3
	17:00	3	8.0	12.0	8.0	160	3
7/01	07:30	2	12.0	8.0	7.0	180	3
	17:00	1	0.0	19.5	8.5	190	3
7/02	07:30	1	0.0	8.0	8.5	203	3
	17:00	4	0.0	19.0	10.0	201	3
7/03	07:30	1	0.0	10.5	9.5	177	3
	17:00	1	0.0	12.0	10.0	158	2
7/04	10:30	2	0.0	16.5	9.5	135	2
7/06	10:30	2	0.0	17.5	12.0	96	1
	17:00	2	0.0	25.0	14.0	92	1
7/07	07:30	4	2.0	17.0	13.0	84	1
	17:00	4	0.0	20.5	12.0	81	1
7/08	07:30	4	2.8	10.0	12.0	75	1
	17:00	4	1.0	17.0	12.0	72	1
7/09	07:30	1	0.0	13.0	11.0	68	1
	17:00	4	0.0	19.5	12.0	66	1
7/10	07:30	4	0.0	10.0	11.0	62	1
	17:00	4	0.0	16.5	12.0	61	1

-continued-

Appendix A2.–Page 2 of 4.

Date	Time	Sky Conditions[a]	Precipitation (mm)[b]	Temperature (°C) Air	Water	River Stage (cm)	Water Clarity[c]
7/11	07:30	4	0.0	12.0	11.0	60	1
	17:00	4	0.0	15.0	11.5	57	1
7/12	10:30	4	0.0	13.0	11.0	56	1
	17:00	4	0.0	17.0	11.0	53	1
7/13	07:30	4	2.2	10.0	10.5	50	1
	17:00	3	2.4	17.0	12.0	49	1
7/14	07:30	4	0.0	10.0	10.5	47	1
	17:00	4	0.0	11.0	11.5	46	1
7/15	07:30	4	0.0	13.5	11.0	46	1
	17:00	4	0.0	18.0	12.0	44	1
7/16	07:30	4	2.4	11.5	11.0	43	1
	17:00	4	0.5	14.0	11.5	40	1
7/17	07:30	4	15.0	7.0	10.0	42	1
	17:00	4	0.5	12.0	10.5	45	1
7/18	07:30	4	0.6	5.0	8.5	57	1
	17:00	2	0.4	17.0	11.0	63	1
7/19	10:30	4	0.0	11.0	10.0	57	1
	17:00	2	0.5	14.0	10.5	56	1
7/20	10:30	3	0.0	11.0	9.5	52	1
	17:00	4	0.0	14.0	10.0	51	1
7/21	07:30	4	7.8	7.0	10.0	50	1
	17:00	1	0.0	13.0	10.0	49	1
7/22	07:30	3	0.0	7.0	8.5	53	1
	17:00	4	0.0	11.0		55	1
7/23	07:30	4	2.2	8.0	10.0	56	1
	17:00	2	1.4	14.0	11.0	54	1
7/24	07:30	1	0.0	8.0	9.0	54	1
	19:00	2	0.0			52	1
7/25	07:30	1	0.0	9.0	10.0	50	1
	17:00	2	0.0	16.0	14.0	48	1
7/26	07:30	4	0.0	11.0	11.0	47	1
	17:00	4	1.7	11.0	11.0	47	1
7/27	07:30	3	0.5	10.0	8.0	46	1
7/28	07:30	2	0.0	7.0	7.0	45	1
	17:00	1	0.0	13.0	11.0	45	1
7/29	07:30	2	0.0	8.0	8.0	42	1
	17:00	4	1.8	11.0	10.0	40	1
7/30	07:30	4	0.5	10.0	7.0	40	1
	17:00	1	0.0	10.0	9.0	37	1
7/31	07:30	2	0.0	9.0	7.0	38	1
	17:00	1	0.0	13.0	11.0	38	1
8/01	07:30	1	0.0	2.0	7.0	38	1
	17:00	4	0.0	18.0	13.0	36	1
8/02	10:30	4	0.0	11.0	7.0	37	1
	17:00	1	0.5	13.0	10.0	35	1
8/03	10:30	1	0.0	10.0	9.0	35	1
	17:00	1	0.0	13.0	12.0	36	1
8/04	07:30	4	0.5	7.0	8.0	35	1
	17:00	3	1.6	15.0	11.0	35	1
8/05	07:30	2	0.0	7.0	9.0	35	1
	17:00	1	0.0	11.5	9.0	35	1
8/06	07:30	1	0.0	-0.5	10.0	30	1
	17:00	3	0.0	16.0	12.0	29	1

-continued-

Appendix A2.–Page 3 of 4.

Date	Time	Sky Conditions[a]	Precipitation (mm)[b]	Temperature (°C) Air	Temperature (°C) Water	River Stage (cm)	Water Clarity[c]
8/07	07:30	2	0.0	8.0	10.0	28	1
	17:00	3	0.0	18.0	12.0	28	1
8/08	07:30	1	0.0	2.0	10.0	26	1
	17:00	2	0.0	19.0	12.0	24	1
8/09	10:30	1	0.0	11.0	10.0	24	1
8/10	10:30	3	0.0	10.0	10.0	25	1
	17:00	2	1.0	15.0	12.0	26	1
8/11	07:30	1	0.0	0.5	10.0	24	1
	17:00	2	0.0	18.0	12.0	24	1
8/12	07:30	5	0.0	1.0	10.0	23	1
	17:00	1	0.0	16.0	14.0	24	1
8/13	07:30	3	0.0	3.0	11.0	25	1
	17:00	3	0.0	15.0	12.0	24	1
8/14	07:30	5	0.5	0.5	11.0	25	1
	17:00	4	0.4	14.0	12.0	25	1
8/15	07:30	4	0.3	3.0	11.0	25	1
	17:00	2	0.0	12.0	13.0	24	1
8/16	10:30	4	1.2	5.0	12.0	24	1
	17:00	3	0.0	13.0	13.0	20	1
8/17	10:30	3	17.5	5.0	12.0	24	1
	18:30	2	0.0			27	1
8/18	07:30	2	0.5	1.0	10.0	41	2
	17:00	3	0.0	11.0	11.0	44	2
8/19	07:30	2	2.0	9.0	10.5	44	2
	17:00	4	0.0	17.0	12.0	43	2
8/20	07:30	2	0.0	10.0	10.0	40	1
	17:00	2	0.0	17.5	12.0	38	1
8/21	07:30	2	0.0	5.0	10.0	34	1
	17:00	3	0.0	17.0	11.5	32	1
8/22	07:30	4	0.0	9.0	10.0	30	1
	17:00	2	0.5	13.0	13.0	29	1
8/23	07:30	1	0.0	6.0	10.0	28	1
	17:00	1	0.0	20.0	13.0	27	1
8/24	07:30	1	0.0	13.0	10.0	26	1
	17:00	1	0.0	19.0	13.0	26	1
8/25	07:30	3	0.0	5.0	9.0	24	1
	17:00	2	0.0	19.0	12.0	23	1
8/26	07:30	4	0.0	5.0	10.0	22	1
	17:00	3	0.0	15.0	12.0	22	1
8/27	07:30	4	0.0	7.0	10.0	21	1
	17:00	3	0.0	18.0	12.5	21	1
8/28	07:30	4	0.0	8.0	10.0	23	1
	17:00	4	0.0	8.0	11.0	25	1
8/29	07:30	5	0.0	-2.0	9.0	25	1
	17:00	2	0.0	15.0	11.0	26	1
8/30	07:30	1	0.0	4.0	9.0	29	1
	17:00	2	0.0	15.0	11.0	28	1
8/31	10:30	4	0.9	10.0	9.0	28	1
	17:00	4	0.0	15.0	10.0	27	1
9/01	10:30	1	0.0	10.0	8.0	25	1
	17:00	2	0.0	22.0	10.0	24	1
9/02	10:30	3	0.0	10.0	8.0	23	1
	17:00	2	0.0	19.0	10.0	23	1

-continued-

Appendix A2.–Page 4 of 4.

Date	Time	Sky Conditions[a]	Precipitation (mm)[b]	Temperature (°C) Air	Water	River Stage (cm)	Water Clarity[c]
9/03	10:30	4	2.6	9.0	9.0	24	1
	17:00	4	0.0	13.0	9.0	23	1
9/04	10:30	4	3.2	9.0	8.0	23	1
	17:00	3	0.5	12.0	9.0	22	1
9/05	10:30	5	0.0	4.0	7.0	22	1
	17:00	1	0.0	13.0	9.0	23	1
9/06	10:30	1	0.0	4.0	7.0	22	1
	17:00	4	0.0	13.0	8.0	22	1
9/07	10:30	1	5.4	9.0	7.0	22	1
	17:00	4	0.3	13.0	8.0	22	1
9/08	10:30	4	1.0	10.0	7.0	22	1
	17:00	1	0.0	12.0	9.0	22	1
9/09	10:30	4	0.0	4.0	8.0	22	1
	17:00	4	0.5	12.0	9.0	21	1
9/10	10:30	4	0.7	9.0	8.0	21	1
	17:00	4	0.3	18.0	9.0	21	1
9/11	10:30	5	0.4	5.0	8.0	19	1
	17:00	3	0.0	10.0	9.0	20	1
9/12	10:30	4	0.3	6.0	7.0	20	1
	17:00	3	1.0	14.0	8.0	20	1
9/13	10:30	4	5.0	9.0	7.0	22	1
	17:00	4	0.6	14.0	8.0	22	1
9/14	10:30	4	1.0	7.0	7.0	22	1
	17:00	3	0.0	10.0	8.0	22	1
9/15	10:30	3	0.0	7.0	7.0	23	1
	17:00	4	0.0	11.0	7.0	23	1
9/16	10:30	3	1.2	6.0	6.0	23	1
	17:00	3	0.4	9.0	7.0	23	1
9/17	10:30	4	4.6	6.0	6.0	24	1
	17:00	3	0.8	9.0	7.0	24	1
9/18	10:30	4	0.3	5.0	6.0	24	1
	17:00	3	1.0	7.0	6.0	24	1
9/19	10:30	3	0.3	5.0	6.0	24	1
	17:00	3	0.0	7.0	6.0	24	1
9/20	10:30	4	0.0	3.0	5.0	23	1
	17:00	3	0.9	7.0	6.0	23	1
9/21	10:30	4	0.3	3.0	5.0	23	1

[a] Sky condition codes:
- 0 = no observation
- 1 = clear or mostly clear; < 10% cloud cover
- 2 = partly cloudy; < 50% cloud cover
- 3 = mostly cloudy; > 50% cloud cover
- 4 = complete overcast
- 5 = thick fog

[b] Represents the cumulative precipitation in the 24 hours prior to the daily morning observation.

[c] Water clarity codes:
- 1 = visibility greater than 1 meter
- 2 = visibility between 0.5 and 1 meter
- 3 = visibility less than 0.5 meter

Appendix A3.–Daily stream temperature summary from Hobo® data logger at the Tatlawiksuk River weir, 2008.

	Temperature (^oC)		
Date	Avg.	Min.	Max.
6/15	12.2	11.5	12.9
6/16	12.2	11.4	13.0
6/17	12.1	11.2	12.8
6/18	12.3	11.0	13.9
6/19	12.8	11.8	14.0
6/20	12.9	12.0	14.4
6/21	13.1	12.3	13.9
6/22	12.5	11.3	13.5
6/23	12.1	11.4	12.9
6/24	11.9	10.8	13.1
6/25	12.4	11.2	13.6
6/26	12.8	11.3	14.4
6/27	13.3	12.0	14.6
6/28	12.0	10.9	13.6
6/29	9.3	8.1	10.8
6/30	7.5	7.3	8.0
7/01	7.8	7.2	8.7
7/02	9.0	8.5	9.9
7/03	9.6	9.4	9.9
7/04	9.9	8.9	11.4
7/05	11.9	11.0	13.4
7/06	13.2	12.3	14.3
7/07	13.7	12.9	14.5
7/08	12.5	11.9	13.7
7/09	11.6	10.9	12.5
7/10	11.6	11.2	12.3
7/11	11.1	10.6	11.6
7/12	10.9	10.2	11.6
7/13	11.2	10.4	12.3
7/14	11.6	10.7	12.8
7/15	11.9	11.5	12.4
7/16	11.4	11.1	11.9
7/17	10.6	10.2	11.1
7/18	10.2	9.6	11.0
7/19	10.3	10.1	10.7
7/20	9.9	9.6	10.2
7/21	9.6	9.0	10.5
7/22	10.2	9.4	11.1
7/23	10.5	9.9	11.2
7/24	10.7	9.5	12.1
7/25	11.6	10.3	13.3
7/26	11.7	11.3	12.5
7/27	11.0	10.2	11.9
7/28	11.2	10.1	12.7
7/29	11.4	10.7	12.1
7/30	10.3	9.7	11.2
7/31	10.0	8.8	11.7
8/01	11.3	9.9	13.0
8/02	11.8	11.5	12.6
8/03	11.0	9.7	12.6
8/04	11.3	10.7	12.0
8/05	11.2	10.1	12.6
8/06	11.0	10.0	12.0
8/07	11.1	10.1	12.5
8/08	11.2	9.8	12.6
8/09	11.3	10.1	12.5
8/10	10.7	9.9	11.8
8/11	11.0	9.5	12.8
8/12	11.7	10.2	13.4
8/13	12.1	11.2	12.8
8/14	11.5	10.7	12.3
8/15	11.8	10.9	13.2
8/16	12.5	11.5	13.8
8/17	12.5	11.8	13.3
8/18	11.8	11.1	12.9
8/19	11.4	10.5	12.5
8/20	11.7	11.0	12.4
8/21	11.0	10.1	11.8
8/22	11.3	10.5	12.3
8/23	11.2	10.1	12.5
8/24	11.4	10.3	12.7
8/25	11.2	10.0	12.6
8/26	11.1	10.2	12.1
8/27	11.1	10.2	12.2
8/28	10.7	10.3	11.3
8/29	9.8	8.7	10.7
8/30	9.9	9.0	10.8
8/31	9.9	9.3	10.4
9/01	9.7	8.7	10.9
9/02	9.8	8.9	10.6
9/03	9.9	9.2	10.7
9/04	9.9	9.3	10.4
9/05	9.4	8.4	10.4
9/06	8.9	8.0	9.8
9/07	8.9	8.5	9.5
9/08	9.3	8.6	10.3
9/09	9.7	9.2	10.1
9/10	9.5	9.0	10.1
9/11	9.5	9.0	10.0
9/12	9.1	8.5	9.7
9/13	9.0	8.7	9.3
9/14	8.8	8.4	9.1
9/15	8.6	8.1	9.1
9/16	8.4	7.9	8.9
9/17	8.2	7.8	8.5
9/18	7.7	7.4	8.1
9/19	7.1	6.7	7.5
9/20	6.8	6.3	7.3
Average:	10.8	10.0	11.7
Minimum:	6.8	6.3	7.3
Maximum:	13.7	12.9	14.6

-continued-

Appendix A4.–Worksheet used to calculate river discharge at Tatlawiksuk River weir on 18 September, 2008.

Location: Tatlawiksuk River weir **Date:** 9/18/2008

Description: Approx. 100 m downstream of weir **Gauge Height:** 26

Crew: Travis Elison, Mike Sakar

Comments: Spin test >2 min. Measurement rating fair **Meter Type:** AA

Station **Dist.** (m)	Stream **Depth** (cm)	Meter **Height** (m)	Substrate Description	**Velocity** (m/sec) Point	Mean Vert.	Mean Cell	Cell Depth (m)	Width (m)	Area (m^2)	Flow (m^3/sec)
0	0		river right, gravel bar							
7.5	7	0.6	gravels and sand	0.341			0.07	2.50	0.175	0.06
10	17	0.6	gravels and sand	0.495			0.17	2.50	0.425	0.21
12.5	21	0.6	gravels and sand	0.748			0.21	2.50	0.525	0.39
15	26	0.6	gravels and sand	0.734			0.26	2.50	0.65	0.48
16.25	28	0.6	gravels and sand	0.932			0.28	2.50	0.7	0.65
17.5	31	0.6	gravels and sand	0.712			0.31	2.50	0.775	0.55
18.25	38	0.6	gravels and sand	1.04			0.38	2.50	0.95	0.99
20	36	0.6	gravels and sand	0.992			0.36	2.50	0.9	0.89
21.25	37	0.6	gravels and sand	1.02			0.37	2.50	0.925	0.94
22.5	37	0.6	gravels and sand	1.16			0.37	2.50	0.925	1.07
23.25	39	0.6	gravels and sand	1.09			0.39	2.50	0.975	1.06
25	37	0.6	gravels and sand	1.09			0.37	2.50	0.925	1.01
26.25	38	0.6	gravels and sand	1.03			0.38	2.50	0.95	0.98
27.5	38	0.6	gravels and sand	1.1			0.38	2.50	0.95	1.05
28.25	38	0.6	gravels and sand	1.02			0.38	2.50	0.95	0.97
30	37	0.6	gravels and sand	0.975			0.37	2.50	0.925	0.90
31.25	35	0.6	gravels and sand	0.994			0.35	2.50	0.875	0.87
32.5	35	0.6	gravels and sand	0.935			0.35	2.50	0.875	0.82
33.25	40	0.6	gravels and sand	0.856			0.40	2.50	1	0.86
35	35	0.6	gravels and sand	0.847			0.35	2.50	0.875	0.74
37.5	27	0.6	gravels and sand	0.785			0.27	2.50	0.675	0.53
40	22	0.6	gravels and sand	0.769			0.22	2.50	0.55	0.42
42.5	17	0.6	gravels and sand	0.806			0.17	2.50	0.425	0.34
45	9	0.6	gravels and sand	0.494			0.09	2.50	0.225	0.11
47.5	18	0.6	gravels and sand	0.754			0.18	2.50	0.45	0.34
50	11	0.6	gravels and sand	0.424			0.11	2.50	0.275	0.12
52.75	0		river left, gravel bar							

Avg. Depth: 26.93 cm Avg. Velocity: 0.85 m/sec

Max. Depth: 40.00 cm Max. Velocity: 1.16 m/sec

Total Discharge: 17.4 m^3/sec

APPENDIX B. DAILY PASSAGE COUNTS

Appendix B1.–Daily observed fish passage at the Tatlawiksuk River weir, 2008.

Date	Chinook Salmon	Sockeye Salmon	Chum Salmon	Pink Salmon	Coho Salmon	Longnose Suckers	White-fish	Other[a]
6/15	0	0	0	0	0	658	0	0
6/16	0	0	2	0	0	162	0	0
6/17	0	0	0	0	0	693	0	0
6/18	0	0	0	0	0	353	0	0
6/19	0	0	0	0	0	13	0	0
6/20	0	0	0	0	0	98	0	0
6/21	0	0	3	0	0	541	1	0
6/22	0	0	5	0	0	197	0	0
6/23	0	0	5	0	0	56	0	0
6/24	0	0	7	0	0	67	1	2 G
6/25	0	0	23	0	0	59	0	0
6/26	2	0	35	0	0	180	0	0
6/27	0	0	49	0	0	249	0	0
6/28	0	0	0	0	0	31	0	0
6/29 [b]								
6/30 [b]								
7/01 [b]								
7/02 [b]								
7/03 [b]								
7/04 [b]								
7/05 [b]								
7/06 [b]								
7/07 [b]								
7/08	8	0	475	0	0	6	0	0
7/09	11	0	702	0	0	0	0	0
7/10	16	2	1,261	0	0	1	0	0
7/11	39	0	1,240	0	0	1	0	0
7/12 [c]	28	0	690	0	0	0	0	0
7/13	51	0	1,808	0	0	1	0	0
7/14	150	0	2,102	0	0	0	0	0
7/15	67	0	1,211	0	0	4	0	0
7/16	28	0	1,388	0	0	0	0	0
7/17	57	0	1,492	0	0	0	0	0
7/18 [c]	50	0	967	0	0	0	0	0
7/19 [c]	14	1	403	1	0	0	0	0
7/20	22	0	1,047	0	0	0	0	0
7/21	81	0	1,216	2	0	0	0	0
7/22	46	0	984	3	0	3	0	0
7/23	34	1	988	0	0	0	0	0
7/24	26	0	952	2	3	1	0	0
7/25	48	0	1,106	0	0	0	0	0
7/26	27	0	701	0	10	6	0	0
7/27	9	2	388	0	5	1	0	0
7/28	27	5	626	2	16	0	0	0
7/29	11	5	547	3	12	0	0	0
7/30	8	1	220	0	4	0	0	0
7/31	11	0	602	1	81	0	0	0
8/01	14	5	563	3	67	0	0	0
8/02	15	1	422	0	28	0	0	0
8/03	9	0	250	0	73	0	0	0
8/04	16	2	287	0	153	0	0	0
8/05	9	0	158	0	82	0	0	0

-continued-

Appendix B1.–Page 2 of 2.

Date	Chinook Salmon	Sockeye Salmon	Chum Salmon	Pink Salmon	Coho Salmon	Longnose Suckers	White-fish	Other[a]	
8/06	13	0	192	1	240	0	0	0	
8/07	2	0	68	0	120	0	0	0	
8/08	3	0	129	0	274	0	0	0	
8/09	2	0	127	0	315	0	0	0	
8/10	0	1	59	0	199	0	0	0	
8/11	2	0	70	0	207	0	0	0	
8/12	2	0	48	1	345	0	0	0	
8/13	0	1	34	0	157	0	0	0	
8/14	0	2	46	0	336	0	0	0	
8/15	0	1	31	0	540	0	0	0	
8/16	0	2	28	0	547	0	0	0	
8/17	0	1	34	0	634	0	0	0	
8/18	0	4	30	0	680	1	0	0	
8/19	0	0	5	0	493	3	0	0	
8/20	0	0	11	0	697	0	0	0	
8/21	0	0	16	0	502	0	0	0	
8/22	0	0	2	0	515	0	0	0	
8/23	0	0	6	0	349	0	0	0	
8/24	0	0	7	0	353	0	0	0	
8/25	1	1	9	0	303	0	1	0	
8/26	0	0	4	0	240	0	0	1	P
8/27	0	0	2	0	323	0	0	1	P
8/28	0	1	4	0	299	0	0	0	
8/29	0	0	4	0	144	0	0	0	
8/30	0	0	0	0	204	0	0	0	
8/31	0	0	8	0	204	0	0	1	P
9/01	0	0	4	0	109	0	0	0	
9/02	0	0	5	0	95	0	0	0	
9/03	0	0	0	0	130	0	0	0	
9/04	0	0	4	0	75	0	0	0	
9/05	0	0	1	0	134	0	0	0	
9/06	0	0	1	0	85	0	0	0	
9/07	0	0	2	0	95	0	0	1	P
9/08	0	0	0	0	78	0	0	0	
9/09	0	0	0	0	61	0	0	0	
9/10	0	0	1	0	76	0	0	0	
9/11	0	0	1	0	38	0	0	0	
9/12	0	0	0	0	33	0	0	1	P
9/13	0	0	0	0	26	0	0	1	P
9/14	0	0	0	0	71	0	0	2	P
9/15	0	0	0	0	33	0	0	1	P
9/16	0	0	0	0	46	0	0	0	
9/17	0	0	2	0	47	0	0	1	P
9/18	0	0	0	0	32	0	0	0	
9/19 [d]									
9/20 [d]									

[a] Letter designations are as follows: P = Northern pike, G = Arctic grayling.
[b] Weir was not operational due to extreme water level.
[c] Counts on this day were incomplete due to the occurrence of a hole in the weir.
[d] Seasonal weir operation was terminated early.

APPENDIX C. DAILY CARCASS COUNTS

Appendix C1.–Daily carcass counts at the Tatlawiksuk River weir, 2008.

	Chinook Salmon			Sockeye Salmon			Chum Salmon			Pink Salmon			Coho Salmon			Longnose	White-	
Date	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Sucker	fish	Other[a]
6/15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 P
6/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 P
6/21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2 P
6/22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2 G;S
6/23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 G
6/24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 G
6/25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 P
6/26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6/28	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	5	2 P
6/29 [b]																		
6/30 [b]																		
7/01 [b]																		
7/02 [b]																		
7/03 [b]																		
7/04 [b]																		
7/05 [b]																		
7/06 [b]																		
7/07 [b]																		
7/08	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	1 P
7/09	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	4	0	0
7/10	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	2	0	0
7/11	0	0	0	0	0	0	2	1	3	0	0	0	0	0	0	1	0	1 S
7/12	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1 P
7/13	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
7/14	0	0	0	0	0	0	4	2	6	0	0	0	0	0	0	1	0	0
7/15	0	0	0	0	0	0	9	2	11	0	0	0	0	0	0	0	0	2 P
7/16	0	0	0	0	0	0	3	1	4	0	0	0	0	0	0	0	1	0
7/17	0	0	0	0	0	0	10	1	11	0	0	0	0	0	0	0	0	0
7/18	0	0	0	0	0	0	16	2	18	0	0	0	0	0	0	0	0	0
7/19	0	0	0	0	0	0	28	3	0	0	0	0	0	0	0	4	0	0
7/20	0	0	0	0	0	0	27	7	34	0	0	0	0	0	0	1	0	0
7/21	0	0	0	0	0	0	40	9	49	0	0	0	0	0	0	2	0	0

-continued-

Appendix C1.–Page 2 of 3.

	Chinook Salmon			Sockeye Salmon			Chum Salmon			Pink Salmon			Coho Salmon			Longnose	White-	
Date	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Sucker	fish	Other[a]
7/22	0	0	0	0	0	0	57	9	66	0	0	0	0	0	0	2	0	0
7/23	0	0	0	0	0	0	73	18	91	0	0	0	0	0	0	0	0	0
7/24	0	0	0	0	0	0	44	18	62	0	0	0	0	0	0	0	0	0
7/25	0	0	0	0	0	0	47	14	61	0	0	0	0	0	0	0	0	0
7/26	0	0	0	0	0	0	44	13	57	0	0	0	0	0	0	0	1	1 P
7/27	0	0	0	0	0	0	47	6	53	0	0	0	0	0	0	0	0	0
7/28	1	0	1	0	0	0	19	4	23	0	0	0	1	0	1	0	0	0
7/29	1	0	1	0	0	0	45	16	61	0	0	0	0	0	0	0	0	1 P
7/30	0	0	0	0	0	0	45	13	58	0	0	0	0	0	0	1	0	1 S
7/31	1	0	0	0	0	0	38	13	51	0	0	0	0	0	0	6	0	1 P
8/01	0	2	2	0	0	0	40	8	48	0	0	0	0	0	0	0	1	1 P
8/02	0	2	2	0	0	0	24	12	36	0	0	0	0	0	0	0	2	0
8/03	0	2	0	0	0	0	35	15	50	0	0	0	0	0	0	0	1	0
8/04	0	5	5	0	0	0	83	34	117	0	0	0	0	0	0	0	3	0
8/05	0	0	0	0	0	0	15	7	22	0	0	0	0	0	0	1	7	0
8/06	0	0	0	0	0	0	51	32	83	2	0	2	0	0	0	4	1	0
8/07	3	0	3	0	0	0	43	27	70	0	0	0	0	0	0	4	7	0
8/08 [c]	2	0	2	0	0	0	27	23	50	0	0	0	0	0	0	0	0	0
8/09 [c]	0	1	1	0	0	0	29	23	52	1	1	2	0	0	0	0	0	0
8/10 [c]	0	0	0	0	0	0	14	13	27	1	0	1	0	0	0	0	1	1 P
8/11 [c]	0	0	0	0	0	0	11	7	18	0	1	1	0	0	0	0	0	0
8/12 [c]	0	3	3	0	0	0	14	6	20	0	0	0	0	0	0	0	4	0
8/13 [c]	0	0	0	0	0	0	8	9	17	0	0	0	0	0	0	0	0	0
8/14 [c]	0	0	0	0	0	0	5	4	9	1	1	2	0	0	0	1	2	0
8/15 [c]	0	1	1	0	0	0	4	6	10	0	0	0	0	0	0	1	1	0
8/16 [c]	0	1	1	0	0	0	7	10	17	0	0	0	0	0	0	0	0	0
8/17 [c]	0	0	0	0	0	0	6	7	13	0	0	0	0	0	0	0	0	0
8/18 [c]	0	0	0	0	0	0	10	8	18	0	0	0	0	0	0	0	0	0
8/19 [c]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/20 [c]	0	0	0	0	0	0	2	1	3	0	0	0	0	0	0	1	0	0
8/21 [c]	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	1	1	1 P
8/22 [c]	0	0	0	0	0	0	1	3	4	0	0	0	0	0	0	1	0	0
8/23 [c]	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0
8/24 [c]	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	6	4	0
8/25 [c]	1	0	1	0	0	0	1	1	2	0	0	0	0	0	0	1	5	0
8/26 [c]	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	4	3	0

-continued-

Appendix C1.–Page 3 of 3.

Date	Chinook Salmon			Sockeye Salmon			Chum Salmon			Pink Salmon			Coho Salmon			Longnose	White-	
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Sucker	fish	Other[a]
8/27 [c]	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	2	4	0 P
8/28 [c]	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	6	7	0
8/29 [c]	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	3	4	0
8/30 [c]	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	4	1	1 P
8/31 [c]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
9/01 [c]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1 G
9/02 [c]	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	4	4	0
9/03 [c]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/04 [c]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6	0
9/05 [c]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0
9/06 [c]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/07 [c]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	5	5	1 S
9/08 [c]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0
9/09 [c]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	8	0
9/10 [c]	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	2	8	0
9/11 [c]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0
9/12 [c]	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	6	0
9/13 [c]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
9/14 [c]	0	0	0	0	0	0	1	0	1	0	0	0	4	0	4	0	3	0
9/15 [c]	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	4	0
9/16 [c]	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	1	1	1 P
9/17 [c]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	1 P
9/18 [c]	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	8	0
9/19 [d]																		
9/20 [d]			23			0			1,429			8			14	93	145	20

[a] S = Sheefish; G = Arctic grayling; P = Northern pike

[b] Weir was not operational due to a high-water event.

[c] Downstream passage chutes were in place, thereby decreasing the carcass deposition.

[d] Seasonal weir operation was terminated early.

APPENDIX D. HISTORICAL DAILY SALMON ESCAPEMENT AT TATLAWIKSUK RIVER WEIR

Appendix D1.–Historical daily Chinook salmon escapement at Tatalawiksuk River weir during the target operational period.

Date	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
6/15	0 [a]	0	0	0 [a]	0 [a]	0 [a]	2	0	0	0	0
6/16	0 [a]	0	0	0 [a]	0 [a]	0 [a]	2	0	0	0	0
6/17	0 [a]	0	0	0 [a]	0 [b]	0 [a]	0	0	0	0	0
6/18	0	0	2	0 [a]	0	0 [a]	4	1	0	0	0
6/19	0	0	2	0 [a]	0	0 [a]	8	1	0	0	0
6/20	1	0	0	0	0	0	3	1	0	0	0
6/21	0	0	0	1	1	0	2	6	0	0	0
6/22	0	0	1	2	19	6	1	7	0	0	0
6/23	8	4	0	1	67	0	0	3	0	0	0
6/24	12	2	10	3	3	5	11	6	0	0	0
6/25	7	2	0	5	2	13	74	5	1	2	0
6/26	12	6	20	71	8	19	241	27	3	8	2
6/27	37	4	2	18	517	3	21	10	22	3	0
6/28	31	14	5	38	21	152	84	5	3	23	0
6/29	23	5	2	15	195	297	75	5	4	1	1 [a]
6/30	5	2	22	105	25	57	43	192	42	0	2 [a]
7/01	99	16	26	364	15	41	315	24	23	92	3 [a]
7/02	182	5	149	24	84	8	131	74	21	22	4 [a]
7/03	171	13	47	27	108	96 [a]	86	481	5	72	5 [a]
7/04	224	26	30	13	135	29 [a]	165	248	128	83	6 [a]
7/05	74	14	42	111	338	59 [a]	243	239 [b]	47	52	7 [a]
7/06	62	15	17	428	64	42 [a]	7	87	187	46	7 [a]
7/07	22 [c]	14	18	170	145	13 [a]	84	140	35	76	9 [a]
7/08	[d]	13	13	21	10	27 [a]	106	98	78	269	8
7/09	[d]	21	73	29	24	129 [a]	229	112	228	488	11
7/10	[d]	40	51	29	27	35 [a]	165	95	146	147	16
7/11	[d]	79 [b]	45	14	48	35 [a]	43	143	46	75	39
7/12	[d]	118	50	48	19	34 [a]	16	101	111	30	64 [e]
7/13	[d]	54	9	150	20	88 [a]	98	86	59	37	51
7/14	[d]	64	0	48	21	65 [a]	29	123	52	27	150
7/15	[d]	24	8	47	103	38 [a]	31	35	41	70	67
7/16	[d]	65	20	12	10	28 [a]	47	96	36	55	28
7/17	[d]	6	47	19	15	18 [a]	161	70	23	52	57
7/18	[d]	146	5	31	3	22 [a]	53	65	65	51	50 [e]
7/19	[d]	20	8	36	15	30 [a]	17	80	52	38 [e]	46 [e]
7/20	[d]	381	10	17	8	72 [a]	12	52	29	29	22
7/21	[d]	18	2	8	14	9 [a]	22	36	24	21	81
7/22	[d]	9	16	21	29	15 [a]	21	24	15	19	46
7/23	[d]	86	7	11	13	17 [a]	26	10	29	15	34
7/24	[d]	46	5	13 [e]	7	25 [a]	19	15	21	31	26
7/25	[d]	33	8	9 [e]	18	16 [a]	13	11	10	37	48
7/26	[d]	18	2	6	4	14 [a]	14	11	5	18	27
7/27	[d]	14 [e]	3	5 [e]	24	14 [a]	26	5	20	11	9
7/28	[d]	10	1	2	20	16 [a]	19	12	8	11	27
7/29	[d]	22	1	8	10	13 [a]	9	14	17	6	11
7/30	[d]	15	6	3	5	8 [a]	2	12	11	5	8
7/31	[d]	6	1	5 [d]	6	16 [a]	15	8	10	5	11
8/01	[d]	6	2	4 [a]	1	6 [a]	0	3	11	4	14
8/02	[d]	1	3 [a]	3 [a]	5	8 [a]	1	7	8	3	15
8/03	[d]	4	8	2 [d]	0	6 [a]	2	5	5	4	9
8/04	[d]	3	2	2	1	2 [a]	4	0	3	4	16
8/05	[d]	5	0	1	0	2 [a]	6	7	2	2	9

-continued-

Appendix D1.–Page 2 of 2.

Date	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
8/06	[d]	3	1	1	0	4 [a]	5	2	6	3 [a]	13
8/07	[d]	2	1	2	1	2 [a]	3	3 [e]	4	2 [a]	2
8/08	[d]	4	3	2	0	2 [a]	4	2	2	2 [a]	3
8/09	[d]	0	1	0	1	2 [a]	0	0	1	2 [a]	2
8/10	[d]	1 [a]	1	1	0	2 [a]	2	0	1	1 [a]	0
8/11	[d]	1 [a]	1	0	0	1 [a]	3	0	0	1 [a]	2
8/12	[d]	1 [a]	0	2	1	3 [a]	0	0	0	0	2
8/13	[d]	1 [a]	1	1	0	3 [a]	1	1	0	1	0
8/14	[d]	1 [a]	2 [c]	0	0	2 [a]	0	1	0	0	0
8/15	[d]	1 [a]	1 [a]	0	2	1 [a]	0	2	0	0	0
8/16	[d]	1 [a]	1 [a]	0	0	1 [a]	1	1	0	0	0
8/17	[d]	1 [a]	0 [a]	0 [a]	0	1 [a]	0	0	0	0	0
8/18	[d]	1 [a]	0 [a]	0 [a]	0	1 [a]	0	1	0	0	0
8/19	[d]	1 [a]	1 [a]	0 [a]	1	1 [a]	0	0	0 [a]	0	0
8/20	[d]	0 [a]	0 [a]	0 [a]	0	2 [a]	0	1	0 [a]	1	0
8/21	[d]	0 [a]	0 [a]	0 [a]	1	1 [a]	3	0	0 [a]	0	0
8/22	[d]	0 [a]	1 [a]	0 [a]	0	1 [a]	1	0	0 [a]	0	0
8/23	[d]	0	0 [a]	0 [a]	0	1 [a]	0	1	0 [a]	0	0
8/24	[d]	1	0 [a]	0 [a]	0	0 [a]	0	1	0 [a]	1	0
8/25	[d]	0	1 [a]	0 [a]	0	0 [a]	0	1	0 [a]	0	1
8/26	[d]	0 [e]	0 [a]	1 [b]	0	0 [a]	0	1	0 [a]	0	0
8/27	[d]	0	0 [a]	0	0	0 [a]	0	0	0 [a]	2	0
8/28	[d]	0	0 [a]	0	0	0 [a]	1	0	0 [a]	0	0
8/29	[d]	0	0 [a]	0	0	0 [a]	0	0	0 [a]	0	0
8/30	[d]	0	0 [a]	0	0	0 [a]	0	0	0 [a]	0	0
8/31	[d]	0	0 [a]	0	0	0 [a]	0	0	0 [a]	0	0
9/01	[d]	1	0 [a]	0	0	0 [a]	1	0	0 [a]	0	0
9/02	[d]	0	0 [a]	0	1	0 [a]	0	0	0 [a]	0	0
9/03	[d]	0	0 [a]	0	0	0 [a]	0	0	0 [a]	0	0
9/04	[d]	0	0 [a]	0	0	0 [a]	0	0	0 [a]	0	0
9/05	[d]	0	0 [a]	0	0	0 [a]	0	0	0 [a]	0	0
9/06	[d]	0	0 [a]	0	1	0 [a]	0	0	0 [a]	1	0
9/07	[d]	0	0 [a]	0	0	0 [a]	0	0	0 [a]	0	0
9/08	[d]	0	0 [a]	0	1	0 [a]	0	0	0 [a]	0	0
9/09	[d]	0	0 [a]	0	0	0 [a]	0	0 [a]	0 [a]	0	0
9/10	[d]	0	0 [a]	0	0	0 [a]	0	0 [a]	0 [a]	0 [e]	0
9/11	[d]	0	0 [a]	0	0 [b]	0 [a]	0	0 [a]	0 [a]	0	0
9/12	[d]	0	0 [a]	0	0 [a]	0 [a]	0	0 [a]	0 [a]	0	0
9/13	[d]	0	0 [a]	0	0 [a]	0 [a]	0	0 [a]	0 [a]	0	0
9/14	[d]	0	0 [a]	0	0 [a]	0 [a]	0	0 [a]	0 [a]	0	0
9/15	[d]	0	0 [a]	0 [a]	0 [a]	0 [a]	0	0 [a]	0 [a]	0	0
9/16	[d]	0	0 [a]	0 [a]	0 [a]	0 [a]	0	0 [a]	0 [a]	0 [a]	0
9/17	[d]	0	0 [a]	0 [a]	0 [a]	0 [a]	0	0 [a]	0 [a]	0 [a]	0
9/18	[d]	0	0 [a]	0 [a]	0 [a]	0 [a]	0	0 [a]	0 [a]	0 [a]	0
9/19	[d]	0	0 [a]	0 [a]	0 [a]	0 [a]	0 [a]	0 [a]	0 [a]	0 [a]	0 [a]
9/20	[d]	0	0 [a]	0 [a]	0 [b]	0 [a]	0 [a]	0	0 [a]	0 [a]	0 [a]

[a] The weir was not operational; daily passage was estimated.
[b] Partial day count; passage was estimated.
[c] Partial day count; passage was not estimated.
[d] The weir was not operational; daily passage was not estimated.
[e] Daily passage was estimated due to the occurrence of a hole in the weir.

Appendix D2.–Historical daily chum salmon escapement at Tatalawiksuk River weir during the target operational period.

Date	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
6/15	0 [a]	0	1	0 [a]	1 [a]	[b]	9	0	0	0	0
6/16	0 [a]	0	1	0 [a]	2 [a]	[b]	15	3	0	0	2
6/17	0 [a]	0	0	0 [a]	4 [c]	[b]	7	0	0	0	0
6/18	0	0	2	0 [a]	2	[b]	22	2	3	0	0
6/19	0	0	0	0 [a]	6	[b]	75	10	0	0	0
6/20	0	0	0	0	3	0	105	4	0	2	0
6/21	5	0	2	3	42	0	53	9	3	3	3
6/22	4	0	7	4	168	1	81	13	12	0	5
6/23	12	0	1	30	262	5	71	7	58	5	5
6/24	25	18	18	22	28	6	169	32	115	15	7
6/25	26	7	30	61	103	4	594	15	234	47	23
6/26	65	18	97	131	483	12	450	36	265	53	35
6/27	197	25	7	69	392	20	175	43	441	101	49
6/28	275	67	10	143	574	106	176	56	267	242	0
6/29	195	67	3	133	834	71	266	130	464	73	81 [a]
6/30	146	58	88	368	634	135	378	366	1,369	143	137 [a]
7/01	464	91	176	440	424	78	462	213	458	785	194 [a]
7/02	529	86	492	143	1,037	41	690	1,605	208	448	250 [a]
7/03	556	101	280	171	501	[b]	660	2,380	764	1,142	307 [a]
7/04	1,005	110	147	162	759	[b]	525	1,110	2,190	1,650	363 [a]
7/05	1,011	94	325	488	1,278	[b]	482	1,387 [c]	347	1,435	419 [a]
7/06	757	141	155	618	1,762	[b]	235	993	1,109	1,898	476 [a]
7/07	454 [d]	171	175	778	809	[b]	638	1,063	745	3,141	532 [a]
7/08	[b]	158	109	900	666	[b]	811	1,439	845	3,732	475
7/09	[b]	324	462	1,061	840	[b]	836	1,748	2,141	5,069	702
7/10	[b]	391	247	1,399	828	[b]	627	1,546	1,791	4,034	1,261
7/11	[b]	404 [d]	391	596	1,238	[b]	425	2,741	1,018	3,366	1,240
7/12	[b]	416	611	1,179	869	[b]	502	2,775	1,365	3,916	1,603 [e]
7/13	[b]	280	169	1,199	702	[b]	967	2,610	1,003	3,632	1,808
7/14	[b]	361	33	1,301	707	[b]	759	3,095	504	2,660	2,102
7/15	[b]	268	266	1,330	1,123	[b]	642	2,780	491	2,755	1,211
7/16	[b]	377	367	1,092	677	[b]	829	3,283	929	3,731	1,388
7/17	[b]	339	257	1,201	959	[b]	863	2,370	979	3,232	1,492
7/18	[b]	404	183	1,607	880	[b]	800	2,260	799	3,436	1,337 [e]
7/19	[b]	160	144	859	707	[b]	655	2,115	1,059	2,906 [e]	1,337 [e]
7/20	[b]	663	88	699	468	[b]	573	2,156	1,106	2,545	1,047
7/21	[b]	306	176	761	504	[b]	557	2,196	1,215	2,409	1,216
7/22	[b]	275	238	650	515	[b]	495	1,422	924	1,891	984
7/23	[b]	628	158	614	409	[b]	513	1,491	962	1,718	988
7/24	[b]	322	152	511 [e]	251	[b]	463	1,152	755	2,657	952
7/25	[b]	338	114	391 [e]	206	[b]	474	1,138	734	2,398	1,106
7/26	[b]	205	85	270	195	[b]	359	1,144	612	1,697	701
7/27	[b]	214 [d]	122	206 [e]	301	[b]	421	794	503	2,266	388
7/28	[b]	222	93	169	224	[b]	344	807	543	1,950	626
7/29	[b]	130	94	178	159	[b]	304	732	597	1,291	547
7/30	[b]	285	141	230	144	[b]	123	680	578	1,113	220
7/31	[b]	141	72	190 [b]	119	[b]	322	587	378	1,024	602
8/01	[b]	171	41	176 [a]	99	[b]	151	344	232	924	563
8/02	[b]	125	37 [a]	163 [a]	59	[b]	124	440	216	911	422
8/03	[b]	141	18	149 [b]	54	[b]	85	486	124	850	250
8/04	[b]	60	15	131	64	[b]	93	266	104	719	287
8/05	[b]	57	8	139	98	[b]	117	265	72	446	158

-continued-

Appendix D2.–Page 2 of 2.

Date	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
8/06	[b]	35	9	96	44	[b]	87	227	115	513 [a]	192
8/07	[b]	43	12	95	55	[b]	99	196 [e]	101	444 [a]	68
8/08	[b]	24	5	62	72	[b]	134	122	73	374 [a]	129
8/09	[b]	42	2	69	30	[b]	43	168	108	305 [a]	127
8/10	[b]	30 [a]	5	36	37	[b]	44	105	22	235 [a]	59
8/11	[b]	28 [a]	7	38	22	[b]	45	62	88	166 [a]	70
8/12	[b]	26 [a]	8	38	25	[b]	26	93	33	77	48
8/13	[b]	24 [a]	9	27	13	[b]	13	63	21	116	34
8/14	[b]	22 [a]	10 [b]	19	5	[b]	22	59	3	84	46
8/15	[b]	20 [a]	4 [a]	23	13	[b]	19	55	1	52	31
8/16	[b]	17 [a]	4 [a]	8	8	[b]	14	44	4	67	28
8/17	[b]	15 [a]	4 [a]	14 [a]	8	[b]	7	16	10	54	34
8/18	[b]	13 [a]	2 [a]	13 [a]	15	[b]	5	28	4	45	30
8/19	[b]	11 [a]	6 [a]	12 [a]	1	[b]	14	19	17 [a]	32	5
8/20	[b]	9 [a]	14 [a]	11 [a]	2	[b]	20	6	11 [a]	37	11
8/21	[b]	7 [a]	8 [a]	9 [a]	1	[b]	9	12	11 [a]	25	16
8/22	[b]	4 [a]	0 [a]	8 [a]	2	[b]	12	33	20 [a]	27	2
8/23	[b]	1 [a]	2 [a]	7 [a]	0	[b]	9	17	1 [a]	19	6
8/24	[b]	1	0 [a]	6 [a]	2	[b]	4	13	3 [a]	14	7
8/25	[b]	0	6 [a]	4 [a]	2	[b]	7	1	1 [a]	15	9
8/26	[b]	2 [e]	2 [a]	3 [a]	2	[b]	5	5	3 [a]	10	4
8/27	[b]	2	2 [a]	2 [c]	0	[b]	4	5	0 [a]	11	2
8/28	[b]	0	2 [a]	1	0	[b]	3	5	3 [a]	8	4
8/29	[b]	0	2 [a]	0	2	[b]	3	4	3 [a]	4	4
8/30	[b]	0	2 [a]	0	1	[b]	0	3	3 [a]	5	0
8/31	[b]	1	0 [a]	0	2	[b]	1	2	0 [a]	4	8
9/01	[b]	0	4 [a]	0	2	[b]	6	0	0 [a]	6	4
9/02	[b]	1	0 [a]	2	1	[b]	0	1	3 [a]	1	5
9/03	[b]	0	2 [a]	1	0	[b]	2	1	1 [a]	8	0
9/04	[b]	0	0 [a]	0	0	[b]	2	2	3 [a]	6	4
9/05	[b]	1	2 [a]	0	1	[b]	1	3	3 [a]	7	1
9/06	[b]	2	0 [a]	0	0	[b]	2	1	1 [a]	5	1
9/07	[b]	0	0 [a]	0	0	[b]	3	1	0 [a]	2	2
9/08	[b]	0	0 [a]	0	0	[b]	0	2	0 [a]	1	0
9/09	[b]	0	0 [a]	0	0	[b]	0	0	1 [a]	2	0
9/10	[b]	0	0 [a]	0	0	[b]	0	1 [a]	0 [a]	2 [e]	1
9/11	[b]	0	0 [a]	0	0	[b]	2	1 [a]	0 [a]	0	1
9/12	[b]	0	0 [a]	0	1 [c]	[b]	1	1 [a]	0 [a]	1	0
9/13	[b]	0	0 [a]	0	0 [a]	[b]	1	1 [a]	0 [a]	1	0
9/14	[b]	0	0 [a]	0	0 [a]	[b]	1	1 [a]	0 [a]	0	0
9/15	[b]	0	0 [a]	0	0 [a]	[b]	2	1 [a]	0 [a]	0	0
9/16	[b]	0	0 [a]	0 [a]	0 [a]	[b]	1	1 [a]	1 [a]	0 [a]	0
9/17	[b]	0	0 [a]	0 [a]	0 [a]	[b]	0	1 [a]	0 [a]	0 [a]	2
9/18	[b]	0	0 [a]	0 [a]	0 [a]	[b]	0	1 [a]	0 [a]	0 [a]	0
9/19	[b]	0	0 [a]	0 [a]	0 [a]	[b]	0 [a]	1 [a]	0 [a]	0 [a]	0 [a]
9/20	[b]	0	0 [a]	0 [a]	0 [c]	[b]	0 [a]	0	0 [a]	0 [a]	0 [a]

[a] The weir was not operational; daily passage was estimated.

[b] The weir was not operational; daily passage was not estimated.

[c] Partial day count; passage was estimated.

[d] Partial day count; passage was not estimated.

[e] Daily passage was estimated due to the occurrence of a hole in the weir.

Appendix D3.–Historical daily coho salmon escapement at Tatalawiksuk River weir during the target operational period.

Date	1998[a]	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
6/15		0	0	0 [b]	0 [b]	[c]	0	0	0	0	0
6/16		0	0	0 [b]	0 [b]	[c]	0	0	0	0	0
6/17		0	0	0 [b]	0 [d]	[c]	0	0	0	0	0
6/18		0	0	0 [b]	0	[c]	0	0	0	0	0
6/19		0	0	0 [b]	0	[c]	0	0	0	0	0
6/20		0	0	0	0	0	0	0	0	0	0
6/21		0	0	0	0	0	0	0	0	0	0
6/22		0	0	0	0	0	0	0	0	0	0
6/23		0	0	0	0	0	0	0	0	0	0
6/24		0	0	0	0	0	0	0	0	0	0
6/25		0	0	0	0	0	0	0	0	0	0
6/26		0	0	0	0	0	0	0	0	0	0
6/27		0	0	0	0	0	0	0	0	0	0
6/28		0	0	0	0	0	0	0	0	0	0
6/29		0	0	0	0	0	0	0	0	0	0 [b]
6/30		0	0	0	0	0	0	0	0	0	0 [b]
7/01		0	0	0	0	0	0	0	0	0	0 [b]
7/02		0	0	0	0	0	0	0	0	0	0 [b]
7/03		0	0	0	0	[c]	0	0	0	0	0 [b]
7/04		0	0	0	0	[c]	0	0	0	0	0 [b]
7/05		0	0	0	0	[c]	0	0 [d]	0	0	0 [b]
7/06		0	0	0	0	[c]	0	0	0	0	0 [b]
7/07		0	0	0	0	[c]	0	0	0	0	0 [b]
7/08		0	0	0	0	[c]	0	0	0	0	0
7/09		0	0	0	0	[c]	0	0	0	0	0
7/10		0	0	0	0	[c]	0	0	0	0	0
7/11		0 [d]	0	0	0	[c]	0	0	0	0	0
7/12		0	0	0	0	[c]	0	0	0	0	0 [e]
7/13		0	0	0	0	[c]	0	0	0	0	0
7/14		0	0	0	0	[c]	0	0	0	0	0
7/15		0	0	0	0	[c]	0	0	0	0	0
7/16		0	0	0	0	[c]	0	0	1	0	0
7/17		0	0	0	0	[c]	0	0	0	0	0
7/18		0	0	0	0	[c]	0	1	0	0	0 [e]
7/19		0	2	0	0	[c]	0	0	1	1 [e]	0 [e]
7/20		0	0	0	0	[c]	1	0	9	2	0
7/21		0	1	0	0	[c]	0	0	17	3	0
7/22		0	0	0	0	[c]	3	2	14	3	0
7/23		0	0	0	0	[c]	6	1	4	1	0
7/24		0	1	0 [e]	0	[c]	7	6	9	3	3
7/25		1	0	0 [e]	0	[c]	3	8	2	3	0
7/26		0	0	0	0	[c]	19	16	2	6	10
7/27		1 [e]	0	0 [e]	3	[c]	31	21	7	13	5
7/28		2	3	1	3	[c]	22	16	16	30	16
7/29		9	2	0	3	[c]	18	19	26	10	12
7/30		1	25	8	8	[c]	15	37	30	34	4
7/31		1	11	18 [d]	3	[c]	106	38	57	38	81
8/01		0	40	29 [b]	5	[c]	55	20	52	50	67
8/02		0	110 [b]	42 [b]	11	[c]	93	29	50	23	28
8/03		0	172	54 [d]	16	[c]	98	70	39	44	73
8/04		0	215	42	4	[c]	128	36	55	59	153
8/05		2	173	91	33	[c]	214	36	47	101	82

-continued-

Appendix D3.–Page 2 of 2.

Date	1998[a]	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
8/06		0	129	47	23	[c]	452	51	152	126 [b]	240
8/07		5	277	74	46	[c]	468	80 [e]	75	172 [b]	120
8/08		1	108	135	43	[c]	437	60	57	218 [b]	274
8/09		1	267	130	79	[c]	497	172	79	264 [b]	315
8/10		3 [b]	619	264	73	[c]	536	118	41	310 [b]	199
8/11		5 [b]	730	212	63	[c]	450	101	54	356 [b]	207
8/12		2 [b]	1,123	306	437	[c]	722	91	102	381	345
8/13		9 [b]	1,429	314	787	[c]	534	73	231	422	157
8/14		12 [b]	319 [f]	864	240	[c]	646	167	176	439	336
8/15		13 [b]	[c]	530	220	[c]	628	82	260	228	540
8/16		27 [b]	[c]	860	345	[c]	515	71	190	275	547
8/17		36 [b]	[c]	652 [b]	53	[c]	575	277	282	353	634
8/18		44 [b]	[c]	610 [b]	349	[c]	591	162	225	343	680
8/19		26 [b]	[c]	567 [b]	27	[c]	716	125	76 [b]	255	493
8/20		71 [b]	[c]	525 [b]	28	[c]	395	118	73 [b]	424	697
8/21		73 [b]	[c]	482 [b]	1,199	[c]	708	111	657 [b]	500	502
8/22		32 [b]	[c]	439 [b]	420	[c]	825	80	251 [b]	343	515
8/23		71 [b]	[c]	397 [b]	1,347	[c]	679	757	1,056 [b]	201	349
8/24		103	[c]	354 [b]	1,027	[c]	473	881	957 [b]	258	353
8/25		88	[c]	311 [b]	542	[c]	638	277	411 [b]	377	303
8/26		93 [e]	[c]	269 [b]	750	[c]	266	199	476 [b]	176	240
8/27		97	[c]	226 [d]	354	[c]	304	194	275 [b]	215	323
8/28		181	[c]	185	345	[c]	259	177	262 [b]	319	299
8/29		171	[c]	182	106	[c]	246	226	167 [b]	229	144
8/30		93	[c]	204	52	[c]	238	162	107 [b]	84	204
8/31		184	[c]	176	368	[c]	284	211	290 [b]	173	204
9/01		239	[c]	64	409	[c]	507	72	241 [b]	112	109
9/02		170	[c]	87	225	[c]	260	92	159 [b]	97	95
9/03		140	[c]	107	92	[c]	281	52	72 [b]	56	130
9/04		190	[c]	88	182	[c]	183	323	253 [b]	95	75
9/05		193	[c]	80	201	[c]	88	264	233 [b]	62	134
9/06		103	[c]	33	79	[c]	137	164	122 [b]	77	85
9/07		30	[c]	43	253	[c]	117	108	181 [b]	51	95
9/08		35	[c]	55	40	[c]	134	159	100 [b]	50	78
9/09		53	[c]	38	62	[c]	119	92	77 [b]	54	61
9/10		303	[c]	13	54	[c]	123	117 [b]	86 [b]	41 [e]	76
9/11		81	[c]	61	53	[c]	149	108 [b]	81 [b]	21	38
9/12		81	[c]	29	51 [d]	[c]	95	99 [b]	75 [b]	39	33
9/13		99	[c]	30	45 [b]	[c]	114	90 [b]	68 [b]	32	26
9/14		82	[c]	38	40 [b]	[c]	85	82 [b]	61 [b]	13	71
9/15		51	[c]	56	36 [b]	[c]	68	73 [b]	54 [b]	8	33
9/16		26	[c]	39 [b]	31 [b]	[c]	19	64 [b]	48 [b]	5 [b]	46
9/17		32	[c]	31 [b]	27 [b]	[c]	23	55 [b]	41 [b]	6 [b]	47
9/18		18	[c]	24 [b]	22 [b]	[c]	7	47 [b]	35 [b]	2 [b]	32
9/19		56	[c]	16 [b]	18 [b]	[c]	0 [b]	38 [b]	8 [b]	0 [b]	25 [b]
9/20		17	[c]	8 [b]	13 [d]	[c]	0 [b]	18	16 [b]	0 [b]	22 [b]

[a] The weir was not operated long enough to enumerate coho salmon in 1998.
[b] The weir was not operational; daily passage was estimated.
[c] The weir was not operational; daily passage was not estimated.
[d] Partial day count; passage was estimated.
[e] Daily passage was estimated due to the occurrence of a hole in the weir.
[f] Partial day count; passage was not estimated.

APPENDIX E. BROOD TABLES

Appendix E1.–Brood table for Tatlawiksuk River Chinook salmon.

Brood Years	Escapement (spawners)	Number by Age in Return Year					Returns[a]	Return per Spawner[a]
		3	4	5	6	7		
1991	ND	ND	ND	ND	ND	-	-	-
1992	ND	ND	ND	ND	-	-	-	-
1993	ND	ND	ND	-	-	-	-	-
1994	ND	ND	-	-	-	-	-	-
1995	ND	-	-	-	-	81	-	-
1996	ND	-	-	-	1,183	-	-	-
1997	ND	-	-	450	-	0	-	-
1998	- [b]	-	517	-	932	42	-	-
1999	1,490 [c]	0	-	1,150	1,040	78	-	-
2000	817 [c]	-	751	1,445	516	28	2,740 [d]	3.35 [d]
2001	2,010 [c]	0	391	749	406	0	1,546	0.77
2002	2,237	0	357	904	346	ND	-	-
2003	1,683 [c]	0	715	615	ND	ND	-	-
2004	2,833	8	110	ND	ND	ND	-	-
2005	2,918	0	ND	ND	ND	ND	ND	ND
2006	1,700	ND	ND	ND	ND	ND	ND	ND
2007	2,061	ND	ND	ND	ND	ND	ND	ND
2008	1,071	ND	ND	ND	ND	ND	ND	ND

[a] Returns do not include downstream harvest.
[b] Insufficient escapement data.
[c] Insufficient age data.
[d] Does not include any possible 3 year old fish.

Appendix E2.–Brood table for Tatlawiksuk River chum salmon.

Brood Years	Escapement (spawners)	Number by Age in Return Year				Returns[a]	Return per Spawner[a]
		3	4	5	6		
1992	ND	ND	ND	ND	-	-	-
1993	ND	ND	ND	-	29	-	-
1994	ND	ND	-	2,660	34	-	-
1995	ND	-	6,959	2,781	93	-	-
1996	ND	10	4,011	7,941	364	12,326	-
1997	ND	139	15,582	8,158	-	-	-
1998	5,726 [b]	100	14,379	-	43	-	-
1999	9,559	1,641	-	9,150	0	-	-
2000	7,044	-	8,942	3,027	85	-	-
2001	23,718	3,110	49,802	13,675	479	67,066	2.83
2002	24,542	2,893	17,945	13,177	627	34,642	1.41
2003	479 [b]	596	66,804	23,548	ND	-	-
2004	24,201	2,786	6,574	ND	ND	-	-
2005	55,720	147	ND	ND	ND	ND	ND
2006	32,301	ND	ND	ND	ND	ND	ND
2007	83,246	ND	ND	ND	ND	ND	ND
2008	30,896	ND	ND	ND	ND	ND	ND

[a] Returns do not include downstream harvest.

[b] Insufficient age data.

Appendix E3.–Brood table for Tatlawiksuk River coho salmon.

Brood Years	Escapement (spawners)	Number by Age in Return Year			Returns[a]	Return per Spawner[a]
		3	4	5		
1994	ND	ND	ND	445	-	-
1995	ND	ND	2,740	-	-	-
1996	ND	278	-	691	-	-
1997	ND	-	9,580	1,087	-	-
1998	ND	231	10,191	ND	-	-
1999	3,455	134	ND	416	-	-
2000	- [b]	ND	15,485	7,496	-	-
2001	10,539 [c]	510	6,727	-	-	-
2002	11,345	330	-	595	-	-
2003	ND	-	7,643	1,316	-	-
2004	16,410	447	9,326	ND	-	-
2005	7,495	422	ND	ND	ND	ND
2006	- [b]	ND	ND	ND	ND	ND
2007	8,685	ND	ND	ND	ND	ND
2008	11,065	ND	ND	ND	ND	ND

[a] Returns do not include downstream harvest.

[b] Insufficient escapement data.

[c] Reported escapement includes 46% passage estimates.